New Cretaceous Index Foraminifera from Northern Alaska

By Helen Tappan [1]

Introduction

Study of rock samples from Naval Petroleum Reserve No. 4, northern Alaska, over a period of about 8 years has shown that among the microfossils occuring in the Cretaceous strata are several new species which because of their stratigraphic importance should be described. Possibly because the strata here considered are of a facies distinct from that of the better known Cretaceous horizons (Tappan, 1951, pp. 3–4), certain of these new species do not fit into any previously described genera and hence new genera are here described to include them.

This paper describes 3 new genera and 34 new species, two-thirds of which are agglutinated forms. The calcareous species described are in large part Nodosariidae and rotaliform genera.

Some reports that are in press or in preparation by other members of the U. S. Geological Survey describe the stratigraphy and structure of northern Alaska as deduced from field study and from information derived by drilling in connection with the petroleum exploration in this region. Further information on the foraminiferal zonation in the surface and subsurface material, as well as foraminiferal range charts for the various wells, is presented in those reports.

The Foraminifera discussed in this paper have been obtained from rocks ranging from Neocomian to Campanian in age. A correlation chart (text-fig. 29) shows how these Alaskan rocks are interrelated and how they fit into the European time scale.

All type specimens of the species described in the present paper are deposited in the U. S. National Museum.

Acknowledgments

The writer is indebted to many of the geologists of the U. S. Geological Survey for collecting the samples from which these Foraminifera were obtained and for supplying the necessary geographic and stratigraphic data. The field geologists are acknowledged by name under the locality data in the descriptions of species.

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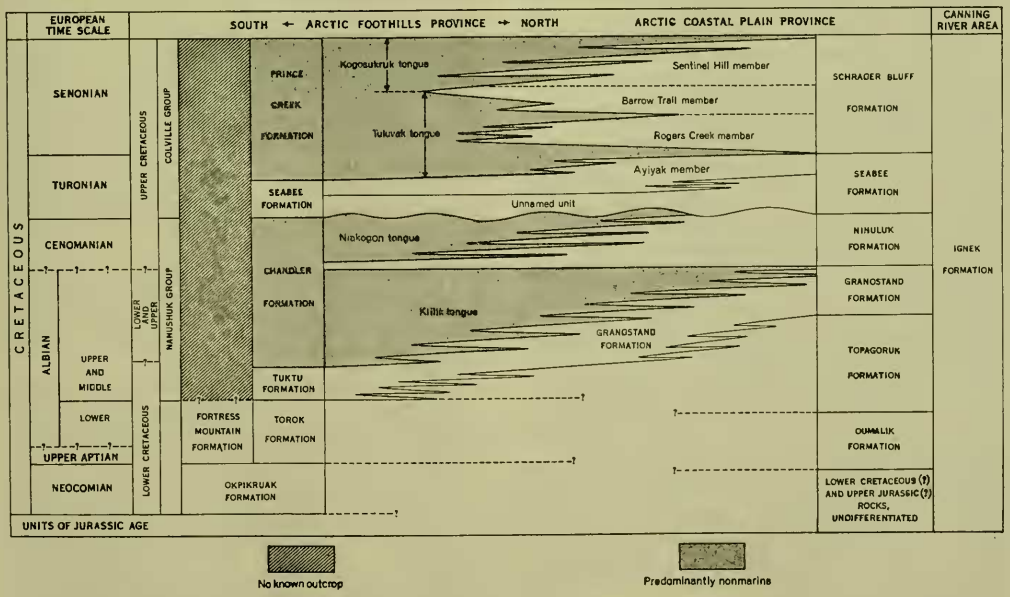

Figure 29.—Cretaceous strata of Northern Alaska and correlation with European time scale (modified after Gryc and others, 1956, and Imlay and Reeside, 1954).

Assistance is also acknowledged from George Gryc, from Harlan Bergquist, who has discussed with the writer many features of the micropaleontology and stratigraphic zonation, and from Florence Robinson and Florence Rucker, who determined lithologic types.

Illustrations for the present paper are shaded camera lucida drawings by the writer and by Patricia Isham, scientific illustrator, Smithsonian Institution.

Systematic Descriptions

Family Rhizamminidae Cushman, 1927

Genus Bathysiphon Sars, 1872

Bathysiphon brosgei Tappan, new species

PLATE 65, FIGURES 1–5

Test free, elongate, consisting of an undivided tubular chamber, commonly straight but rarely somewhat irregularly bent or curved; wall finely agglutinated with considerable cement, rather smoothly finished, surface may have transverse growth wrinkles, irregularly spaced; aperture rounded at the open end of the tubular chamber.

Length of holotype 1.22 mm., greatest breadth 0.31 mm. Other specimens range from 0.34 to 1.66 mm. in length and from 0.10 to 0.32 mm. in breadth.

REMARKS: *Bathysiphon brosgei* Tappan, new species, differs from the associated *B. vitta* Nauss in being much narrower, about one-third to one-fifth as broad, and in having a somewhat more roughened surface. It is similar in appearance to the figures of *B. alexanderi* Cushman, but an examination of the type specimens of the latter shows them to be inorganic limonitic sticks, and not Foraminifera. *B. brosgei* occurs throughout the Nanushuk group and the underlying Fortress Mountain formation. It is named in honor of W. P. Brosgé, geologist, U. S. Geological Survey.

TYPES AND OCCURRENCE: Holotype (USNM P4216), figured paratypes (USNM P4217a,b) and unfigured paratypes (USNM P4218) from the Topagoruk formation in a core at 2,235–2,245 feet, unfigured paratypes (USNM P4219) from a core at 1,247–1,267 feet, unfigured paratype (USNM P4220) from a core at 1,197–1,207 feet, all from Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Unfigured paratype (USNM P4221) from well cuttings at 3,650–3,660 feet and unfigured paratype (USNM P4222) from well cuttings at 3,930–3,940 feet, both in the Topagoruk formation in Umiat test well 1, at lat. 69°23′52″ N., long. 152°19′45″ W., west of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratypes (USNM P4223) from well cuttings at 2,640–2,650 feet and figured paratypes (USNM P4224a,b) from well cuttings at 2,670–2,680 feet, all in the Topagoruk formation in Umiat test well 2, at lat. 69°23′04″ N., long. 152°05′01″ W., north of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratypes (USNM P4225) from the Fortress Mountain formation (field sample 49A Pa 125), on a small north-flowing tributary to Fortress Creek, which flows into the Ayiyak River, northeast of Fortress Mountain, lat. 68°30′ N., long. 153°05′30″ W., in the southern foothills of the Brooks Range, northern Alaska. Collected by W. W. Patton, Jr., 1949.

Family Hyperamminidae Cushman, 1910

Genus Hyperamminoides Cushman and Waters, 1928

Hyperamminoides barksdalei Tappan, new species

PLATE 65, FIGURES 6–12

Test free, flattened, elongate, somewhat flaring, consisting of an undivided tubular chamber with occasional growth wrinkles or constrictions but without internal partitions; wall finely arenaceous, smoothly finished; aperture a rounded opening at the somewhat constricted end of the chamber.

Length of holotype 0.55 mm., breadth 0.26 mm. Paratypes range from 0.26 to 1.12 mm. in length.

REMARKS: *Hyperamminoides barksdalei*, Tappan, new species, differs from *H. elegans* (Cushman and Waters) in being less tapering and much smaller and in having less constricted transverse growth wrinkles. This species occurs in the Topagoruk and Grandstand formations. It is named in honor of W. L. Barksdale, geologist, formerly with the U. S. Geological Survey.

TYPES AND OCCURRENCE: Holotype (USNM P4386) from a core at 196–201 feet and unfigured paratypes (USNM P4387) from a core at 438–443 feet in the Grandstand formation; and unfigured paratypes (USNM P4388) from a core at 1,302–1,312 feet in the Topagoruk formation; all from Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Figured paratype (USNM P4389) from well cuttings at 2,110–2,120 feet in the Topagoruk formation, in South Barrow test well 1, at lat. 71°19′12″ N., long. 156°42′16″ W., southwest of Point Barrow, northern Alaska.

Figured paratype (USNM P4390) and unfigured paratypes (USNM P4391) from a core at 660–670 feet in the Topagoruk formation, in South Barrow test well 2, at lat. 71°15′49″ N., long. 156°38′03″ W., south-southwest of Point Barrow, northern Alaska.

Unfigured paratypes (USNM P4392) from a core at 950–960 feet in the Topagoruk formation, in Arcon Point Barrow core test 1, at lat. 71°20′ N., long. 156°40′ W., southwest of Point Barrow, northern Alaska.

Figured paratype (USNM P4226) from the Grandstand formation, 2,000 feet below the top (field sample 47A Dt 236), about 4½ miles airline upstream from

the mouth of Fossil Creek, a small north-flowing tributary to the Colville River, approximately at lat. 69°19′15″ N., long. 152°28′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by R. L. Detterman, 1947.

Figured paratype (USNM P4227) from the lower part of the Topagoruk formation, west fork of Birthday Creek, Awuna River area (field sample 47A Wh 541), lat. 69°11′30″ N., long. 156°41′ W., northern Alaska. Collected by C. L. Whittington, 1947.

Figured paratype (USNM P4228) from well cuttings at 1,370–1,380 feet, figured paratype (USNM P4229) from well cuttings at 3,300–3,310 feet, and unfigured paratypes (USNM P4230) from well cuttings at 1,290–1,300 feet, all in the Topagoruk formation, Umiat test well 2, lat. 69°23′04″ N., long. 152°05′01″ W., north of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratypes (USNM P4231) from the Grandstand formation (field sample 47A Tr 108), north limb of Awuna anticline, on Discovery Creek, lat. 69°14′ N., long. 157°25′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by M. L. Troyer, 1947.

Family Tolypamminidae Cushman, 1929

Genus Involutina Terquem, 1862

Involutina mangusi Tappan, new species

PLATE 65, FIGURES 13, 14

Test free, discoidal, consisting of proloculus and long undivided, planispiral, evolute second chamber, which is relatively thick and forms only a few whorls; specimens commonly compressed in preservation, surface granular in appearance; wall finely to moderately coarsely agglutinated; aperture at the open end of the tubular chamber.

Greatest diameter of holotype 0.49 mm., thickness 0.06 mm. Paratypes range from 0.36 to 0.68 mm. in diameter.

REMARKS: *Involutina mangusi* Tappan, new species, differs from *Ammodiscus gaultinus* Berthelin in being about one-half as large, in having a relatively thicker spiralling chamber, and in being more coarsely agglutinated. The present species is more evenly planispiral, rather than irregularly coiled in the early stages as in *A. gaultinus*. The species is found in the Topagoruk and Grandstand formations and marine tongues in the equivalent Chandler formation. It is named in honor of M. D. Mangus, geologist, U. S. Geological Survey.

TYPES AND OCCURRENCE: Holotype (USNM P4232) and unfigured paratype (USNM P4233) from a core at 1,080–1,087 feet, unfigured paratype (USNM P4234) from a core at 1,187–1,197 feet, unfigured paratypes (USNM P4235) from a core at 1,247–1,267 feet, all in the Topagoruk formation; and unfigured paratype (USNM P4236) from a core at 673–683 feet in the Grandstand formation; all from Simpson test well 1, lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Unfigured paratypes (USNM P4237) from a core at 548–558 feet in the Topagoruk formation, in Arcon Point Barrow core test 1, at lat. 71°20′ N., long. 156°40′ W., southwest of Point Barrow, northern Alaska.

Unfigured paratype (USNM P4238) from well cuttings at 1,130–1,140 feet and unfigured paratype (USNM P4239) from well cuttings at 1,140–1,150 feet in the Topagoruk formation, in South Barrow test well 1, at lat. 71°19′12″ N., long. 156° 42′15″ W., southwest of Point Barrow, northern Alaska.

Paratype (fig. 14; USNM P4240) from field sample 47A Wh 623, residual soil of marine zone in Chandler formation, on the south flank of the Awuna anticline, lat. 69°03′18″ N., long. 156°02′30″ W., northern Alaska. Collected by C. L. Whittington, 1947.

Unfigured paratype (USNM P4241) from field sample 47A Wh 688, residual soil sample of the Grandstand formation on the south flank of the Awuna anticline, lat. 69°02′48″ N., long. 155°59′30″ W., northern Alaska. Collected by C. L. Whittington, 1947.

Family Lituolidae Reuss, 1861

Genus Haplophragmoides Cushman, 1910

Haplophragmoides topagorukensis Tappan, new species

PLATE 65, FIGURES 15–25

Test free, planispiral and involute, occasional specimens partly evolute, biumbilicate, periphery rounded, 8 to 12 chambers in the final whorl, increasing gradually in size as added, and slightly inflated; sutures straight and radial, somewhat thickened, moderately depressed; wall finely agglutinated, with variable amount of cement, test apparently not extremely rigid in original character, as most tests are distorted in preservation, those laterally crushed having the appearance of a more sharply angled periphery; surface generally smoothly finished, but those specimens from sandy horizons commonly possessing a more roughened exterior; aperture an arch at the base of the final chamber face on the periphery.

Greatest diameter of holotype 0.62 mm., thickness 0.08 mm. Paratypes range from 0.31 to 1.87 mm. in greatest diameter.

REMARKS: This is an extremely variable species in size; and because of the prevalence of distorted tests due to compression in preservation, it is variable in apparent relative thickness and angularity of periphery. However, as there are specimens crushed in different directions as well as some pyrite-filled tests which are

less distorted, it is possible to determine the true characters. It is found in the Grandstand and Topagoruk formations, the upper part of the Torok of the surface sections, and in marine zones within the Chandler formation.

The species differs from *Haplophragmoides collyra* Nauss in having more numerous chambers in the final whorl and a less lobulate periphery. It is distinguished from *H. eggeri* Cushman in being about twice as large and in having about double the number of chambers in the final whorl.

It occurs at approximately the same stratigraphic position as does *Haplophragmoides gigas* Cushman in Canada, in beds of middle and upper Albian age. Although similar to *H. gigas* in size, and possibly related to it, the present species lacks the distinctly sinuate sutures and the raised umbilical margins which are characteristic of the Canadian form.

Types and occurrence: Holotype (USNM P4242) and unfigured paratypes (USNM P4243) from a core at 1,322–1,330 feet in the Topagoruk formation; unfigured paratypes (USNM P4244) from a core at 303–308 feet, unfigured paratypes (USNM P4245) from a core at 443–444 feet, figured paratypes (USNM P4246a,b) and unfigured paratypes (USNM P4247) from a core at 533–543 feet, unfigured paratypes (USNM P4248) from a core at 565–578 feet, unfigured paratypes (USNM P4249) from a core at 578–588 feet, and unfigured paratypes (USNM P4250) from a core at 713–723 feet, all in the Grandstand formation; unfigured paratypes (USNM P4251) from a core at 1,227–1,237 feet, figured paratype (USNM P4252) and unfigured paratypes (USNM P4253) from a core at 1,247–1,267 feet, figured paratype (USNM P4254) and unfigured paratypes (USNM P4255) from well cuttings at 1,730–1,740 feet, unfigured paratypes (USNM P4256) from well cuttings at 1,830–1,840 feet, figured paratype (USNM P4257) and unfigured paratypes (USNM P4258) from a core at 2,235–2,245 feet, unfigured paratypes (USNM P4259) from a core at 2,739–2,749 feet, unfigured paratypes (USNM P4260) from well cuttings at 2,760–2,770 feet, and unfigured paratypes USNM P4261) from well cuttings at 2,880–2,890 feet, all in the Topagoruk formation; all from Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Unfigured paratypes (USNM P4262) from well cuttings at 1,180–1,190 feet and (USNM P4263) at 1,370–1,380 feet in the Topagoruk formation, from South Barrow test well 1, lat. 71°19′12″ N., long. 156°42′15″ W., southwest of Point Barrow, northern Alaska.

Unfigured paratypes (USNM P4269) from a core at 264 feet in the Grandstand formation, in Skull Cliff core test 1, at lat. 70°55′ N., long. 157°38′ W., southwest of Point Barrow, and approximately midway between Point Barrow and Point Franklin, northern Alaska.

Figured paratype (USNM P4270) from a core at 3,776–3,786 feet in the Topagoruk formation, in Fish Creek test well 1, at lat. 70°18′36″ N., long. 151°52′40″ W., about 15 miles west of the mouth of the Colville River, northern Alaska.

Unfigured paratypes (USNM P4271) from a core at 1,615–1,625 feet and unfigured paratypes (USNM P4272) from a core at 1,625–1,635 feet, unfigured paratypes (USNM P4273) from a core at 2,347–2,357 feet, and unfigured paratypes (USNM P4274) from a core at 2,365–2,370 feet, all in the Grandstand formation; and figured paratype (USNM P4275) from well cuttings at 3,660–3,670 feet and unfigured paratypes (USNM P4276) from well cuttings at 4,110–4,120 feet, all in the Topagoruk formation; all in Umiat test well 1, west of Umiat, at lat. 69°23′52″ N., long. 152°19′45″ W., in the northern foothills of the Brooks Range, northern Alaska.

Figured paratype (USNM P4277) and unfigured paratypes (USNM P4278) from cuttings at 2,400–2,410 feet and figured paratype (USNM P4279) from cuttings at 2,950–2,960 feet, all in the Topagoruk formation, in Umiat test well 2, north of Umiat, at lat. 69°23′04″ N., long. 152°05′01″ W., in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratypes (USNM P4280) from the upper part of the Torok formation, equivalent of the upper part of the Topagoruk formation in the subsurface, about 2,960 feet below the top of the Grandstand formation (field sample 47A Dt 223), 5 miles airline upstream from the mouth of Fossil Creek, a small north-flowing tributary to the Colville River. Unfigured paratypes (USNM P4281) from the Grandstand formation, 2,390 feet below the top (field sample 47A Dt 227), about ¼ mile farther upstream; unfigured paratypes (USNM P4282) from the Grandstand formation, 2,000 feet below the top (field sample 47A Dt 236), about ¼ mile farther upstream; and unfigured paratypes (USNM P4283) from the Grandstand formation, 1,450 feet below the top (field sample 47A Dt 244), about 1¼ miles farther upstream, from approximately lat. 69°19′30″ N., to 69°18′40″ N., long. 152°28′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by R. L. Detterman, 1947.

Unfigured paratypes (USNM P4284) from the Grandstand formation (field sample 48A Dt 336) on Trouble Creek, Big Bend anticline, at lat. 69°06′30″ N., long. 151°38′ W., in the area of the Chandler River, northern foothills of the Brooks Range, northern Alaska. Collected by R. L. Detterman, 1948.

Unfigured paratypes (USNM P4285) from the Grandstand formation, 140 feet below the base of the Ninuluk formation (field sample 48A Dt 268), Chandler River, Niakogon syncline to Big Bend anticline, lat. 69°04′ N., long. 151°52′ W., northern Alaska. Collected by R. L. Detterman, 1947.

Unfigured paratypes (USNM P4286) from a marine zone in the Chandler formation (field sample 47A Tr 241), north flank of Awuna anticline, lat. 69°12′18″ N., long. 155°47′ W., northern Alaska. Collected by M. L. Troyer, 1947.

Unfigured paratype (USNM P4287) from well cuttings at 250–260 feet in the Grandstand formation, in

Simpson core test 8, lat. 70°56′43″ N., long. 155°17′16″ W., northern Alaska.

Figured paratype (USNM P4288) and unfigured paratype (USNM P4289) from a core at 529–532 feet in the Grandstand formation, in Umiat test well 3, lat. 69°23′16″ N., long. 152°05′14″ W., north of Umiat, northern Alaska.

Family Textulariidae d'Orbigny, 1846

Genus Spiroplectammina Cushman, 1927

Spiroplectammina koveri Tappan, new species

PLATE 66, FIGURES 1, 2

Test free, tiny, elongate, early chambers in a planispiral coil, later chambers biserially arranged, increasing gradually in breadth as added, but increasing more rapidly in relative height, from five to six pairs of biserial chambers; sutures distinct, depressed, slightly oblique; wall finely agglutinated, rather smoothly finished; aperture a low arch at the base of the final chamber.

Length of holotype 0.49 mm., greatest breadth 0.18 mm., greatest thickness 0.06 mm. Paratype specimens range from 0.34 to 0.57 mm. in length.

REMARKS: This species differs from *Spiroplectammina longa* Lalicker in being smaller and less tapering, and in the more gradual increase in chamber size with development. It occurs in the Topagoruk formation.

It is named in honor of A. N. Kover, geologist, U. S. Geological Survey.

TYPES AND OCCURRENCE: Holotype (USNM P4290) and unfigured paratypes (USNM P4291) from a core in the Topagoruk formation at 459–469 feet, in South Barrow test well 2, at lat. 71°15′15″ N., long. 156° 37′55″ W., south-southwest of Point Barrow, northern Alaska.

Figured paratype (USNM P4292) and unfigured paratypes (USNM P4293) from a core at 1,342–1,352 feet in the Topagoruk formation, in Arcon Point Barrow core test 1, at lat. 71°20′ N., long. 156°40′ W., southwest of Point Barrow, northern Alaska.

Unfigured paratypes (USNM P4294) from a core at 1,030–1,040 feet in the Topagoruk formation, in Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Unfigured paratype (USNM P4295) from seismograph party 47, line 27–48, shot hole 8, at 190–200 feet, lat. 71°15′58″ N., long. 156°37′27″ W., northern Alaska.

Spiroplectammina webberi Tappan, new species

PLATE 66, FIGURES 3–5

Test free, small, elongate, base rounded with early portion planispiral, later biserial with sides gradually flaring; chambers increasing gradually in size, about three or four pair of biserial chambers, of nearly equal height and breadth; sutures slightly depressed, nearly horizontal in the biserial portion; wall agglutinated, of fine to medium grains, roughly finished; aperture at the base of the inner margin of the chamber.

Length of holotype 0.44 mm., breadth 0.21 mm., thickness 0.08 mm. Paratypes range from 0.26 to 0.88 mm. in length.

REMARKS: This species differs from *S. mordenensis* Wickenden in being larger and more compressed, in having a relatively smaller coil, higher biserial chambers, and a more flaring test. It occurs throughout the Colville group, from the Seabee formation to the Sentinel Hill member of the Schrader Bluff formation.

The species is named in honor of E. J. Webber, geologist, formerly with the U. S. Geological Survey.

TYPES AND OCCURRENCE: Holotype (USNM P4348) and unfigured paratypes (USNM P4349) from the Seabee formation (field sample 47A Wb 150) and unfigured paratypes (USNM P4350) from the Seabee formation (field sample 47A Wb 155) both samples from an outcrop on the Nanushuk River, south-southeast of Umiat, at approximately lat. 69°03′ N., long. 150°56′ W., in northern Alaska. Collected by E. J. Webber, 1947.

Unfigured paratypes (USNM P4351) from 31 to 42 feet above the base of the Sentinel Hill member of the Schrader Bluff formation (field sample 47A St 25), on the north bank of the Colville River, about 7½ miles southwest of the confluence with the Chandler River, at approximately lat. 69°25′ N., long. 151°48′ W., northern Alaska. Collected by Karl Stefansson, 1947.

Figured paratypes (USNM P4352 a, b) and unfigured paratypes (USNM P4353) from a core at 1,110–1,120 feet in the Sentinel Hill member of the Schrader Bluff formation, in Sentinel Hill core test 1, at lat. 69°37′30″ N., long. 151°27′ W., on the west bank of the Colville River, northern Alaska.

Unfigured paratypes (USNM P4354) from a core at 490–499 feet in the Seabee formation, in Umiat test well 1, west of Umiat, at lat. 69°24′ N., long. 154°20′ W., in the northern foothills of the Brooks Range, northern Alaska.

Genus Textularia Defrance, 1824

Textularia topagorukensis Tappan, new species

PLATE 66, FIGURES 8, 9

Test free, tiny, tapering, biserial throughout; chambers numerous, somewhat inflated, increasing gradually in size; wall finely agglutinated, commonly crushed and distorted in preservation; aperture at the base of the final chamber.

Length of holotype 0.46 mm., breadth 0.17 mm., thickness 0.07 mm. Paratypes range from 0.23 to 0.60 mm. in length.

REMARKS: *Textularia topagorukensis*, new species, differs from *T. rollaensis* Stelck and Wall in the lower and more numerous chambers, more horizontal sutures, and more nearly parallel sides. It is found in the Grandstand and Topagoruk formations.

TYPES AND OCCURRENCE: Holotype (USNM P4296) and unfigured paratypes (USNM P4297) from a core

at 459–469 feet and figured paratype (USNM P4302) from well cuttings at 1720–1730 feet, in the Topagoruk formation, in South Barrow test well 2, at lat. 71°15′15″ N., long. 156°37′55″ W., south-southwest of Point Barrow, northern Alsaka.

Unfigured paratypes (USNM P4298) from a core at 2,235–2,245 feet, unfigured paratypes (USNM P4299) from a core at 2,939–2,949 feet, all in the Topagoruk formation, in Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Unfigured paratypes (USNM P4300) from a core at 1,600–1,610 feet in the Topagoruk formation, in South Barrow test well 1, at lat. 71°19′12″ N., long. 156°42′15″ W., northern Alaska.

Unfigured paratypes (USNM P4303) from a core at 256–264 feet in the Grandstand formation, in Skull Cliff core test 1, at lat. 70°55′ N., long. 157°38′ W., midway between Point Barrow and Point Franklin, northern Alaska.

Genus Siphotextularia Finlay, 1939

Siphotextularia? rayi Tappan, new species

Plate 66, Figures 6, 7

Test free, biserial, somewhat flaring; chambers inflated, relatively high, and increasing rapidly in size; sutures distinct, depressed, horizontal; wall finely agglutinated, smoothly finished, white; aperture a slit in the terminal face of the final chamber, not extending to the base of the chamber.

Length of holotype 0.55 mm., breadth 0.31 mm., thickness 0.08 mm. Paratypes range from 0.44 to 0.60 mm. in length.

Remarks: *Siphotextularia? rayi*, new species, differs from *S. washitensis* Loeblich and Tappan in being larger, with higher and more inflated chambers and more nearly horizontal sutures. It is not a typical *Siphotextularia* in that it is not quadrangular in section, but seems closest to that genus in the terminal apertural character, although the aperture is not produced on a neck. It occurs in the Grandstand and Topagoruk formations.

The specific name is in honor of R. G. Ray, geologist, U. S. Geological Survey.

Types and occurrence: Holotype (USNM P4304) and unfigured paratypes (USNM P4305) from a core at 660–670 feet in the Topagoruk formation, in South Barrow test well 2, at lat. 71°15′15″ N., long. 156°37′55″ W., south-southwest of Point Barrow, northern Alaska.

Figured paratype (USNM P4306) from well cuttings at 857–867 feet and unfigured paratypes (USNM P4307) from well cuttings at 1,086–1,091 feet, all in the Topagoruk formation, in Arcon Point Barrow core test 1, at lat. 71°19′30″ N., long. 156°40′ W., north-northeast of Barrow Village, northern Alaska.

Unfigured paratypes (USNM P4308) from a core at 2,235–2,345 feet in the Topagoruk formation, in Simpson test well 1, at lat. 70°57′05″ N., long. 155°-21′45″ W., west of Cape Simpson, northern Alaska.

Unfigured paratype (USNM P4309) from seismograph party 47, line 14 A–48, shot hole 35, at 110–120 feet in the Grandstand formation, at lat. 71°18′08″ N., long. 156°42′45″ W., northern Alaska.

Family Verneuilinidae Cushman, 1911

Genus Verneuilinoides Loeblich and Tappan, 1949

Verneuilinoides borealis Tappan, new species

Plate 66, Figures 10–18

Test free, elongate, triserial, axis commonly slightly twisted, rounded in section, broadly flaring, rarely more elongate and less flaring in the later portion; chambers increasing rapidly in size, normally inflated, but in many specimens the tests are crushed in preservation; sutures distinct, depressed; wall commonly finely agglutinated, or may be relatively coarse grained, probably reflecting the character of the local depositional environment; aperture a low arch at the base of the final chamber.

Length of holotype 0.49 mm., breadth 0.18 mm. Paratypes range in length from 0.26 to 1.17 mm.

Remarks: This species is extremely variable in size, degree of flaring, coarseness of texture, and type of preservation. Commonly the specimens are crushed and distorted, but more rarely specimens are filled with pyrite, which preserves the original form and inflation of the chambers. It is one of the most abundant species in the northern Alaska strata. It differs from *Verneuilinoides perplexa* var. *gleddiei* Stelck and Wall in being considerably larger and more flaring.

V. borealis occurs in the Grandstand and Topagoruk formations, in equivalent marine zones in the Chandler formation, and in the upper part of the surface Torok formation.

Types and occurrence: Holotype (USNM 106131), figured paratype (USNM 106132), and unfigured paratypes (USNM 106133) from a core at 1,810–1,816 feet, unfigured paratypes (USNM P4310) from a core at 1,635–1,645 feet, unfigured paratypes (USNM P4311) from a core at 1,693–1,703 feet, unfigured paratypes (USNM P4312) from a core at 2,365–2,370 feet, all in the Grandstand formation; and unfigured paratypes (USNM P4313) from well cuttings at 3,890–3,900 feet and unfigured paratypes (USNM P4314) from well cuttings at 4,860–4,870 feet in the Topagoruk formation; all in Umiat test well 1, at lat. 69°23′52″ N., long. 152°19′45″ W., west of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratypes (USNM P4315) from a core at 469 feet and unfigured paratypes (USNM 106135) from a core at 785–788 feet in the Grandstand formation, in Umiat test well 2, at lat. 69°23′04″ N., long. 152°05′01″ W., north of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratypes (USNM 106134) from a core at 361–366 feet in the Grandstand formation, in Umiat test well 3, at lat. 69°23′16″ N., long. 152°05′14″ W.,

north of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratypes (USNM P4316) from field sample 48A Dt 328, in a marine zone interfingered with the Chandler formation, Chandler River, Big Bend anticline, lat. 69°07′30″ N., long. 151°45′ W., northern Alaska. Collected by R. L. Detterman, 1948.

Figured paratype (USNM P4317) and unfigured paratypes (USNM P4318) from a core at 461–466 feet in the Grandstand formation, in Skull Cliff core test 1, at lat. 70°55′ N., long. 157°38′00″ W., between Point Barrow and Point Franklin, northern Alaska.

Figured paratype (USNM P4319) and unfigured paratypes (USNM P4320) from a core at 308–318 feet, and unfigured paratypes (USNM P4321) from a core at 533–543 feet, all in the Grandstand formation; and unfigured paratypes (USNM P4322) from a core at 2,275–2,285 feet in the Topagoruk formation; all from Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Unfigured paratype (USNM P4323) from a core at 231.5 to 233 feet in the Grandstand formation, in Simpson core test 3, at lat. 70°55′27″ N., long. 155°16′55″ W., northern Alaska.

Unfigured paratypes (USNM P4324) from a core at 342–352 feet in the Grandstand formation, in Simpson core test 8, at lat. 70°56′43″ N., long. 155°17′16″ W., northern Alaska.

Unfigured paratypes (USNM P4325) from well cuttings at 150–160 feet, figured paratype (USNM P4326) and unfigured paratypes (USNM P4327) from well cuttings at 170–180 feet, and unfigured paratypes (USNM P4328) from well cuttings at 180–190 feet, all from the Grandstand formation, in Oumalik core test 2, at lat. 69°50′18″ N., long. 155°59′24″ W., northern Alaska.

Figured paratypes (USNM P4329a–d) and unfigured paratypes (USNM P4330) from the Grandstand formation (field sample 46A Th 165), on the Colville River, lat. 69°06′ N., long. 154°24′ W., northern Alaska. Collected by R. F. Thurrell, 1946.

Unfigured paratypes (USNM P4331) from the Grandstand formation (field sample 47A Dt 240), about 3½ miles airline upstream from the mouth of Fossil Creek, a north-flowing tributary to the Colville River, at approximately lat. 69°19′05″ N., long. 152°28′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by R. L. Detterman, 1947.

Unfigured paratypes (USNM P4332) from field sample 48A Dt 2, upper part of the Torok formation (equivalent to the Topagoruk formation in the subsurface) at Tuktu Bluff on the Chandler River, lat. 68°43′ N., long. 152°15′ W., northern Alaska. Collected by R. L. Detterman, 1948.

Unfigured paratypes (USNM P4333) from the lower part of a 50-foot section on the west fork of Birthday Creek (field sample 47A Tr 167), 80 feet below the top of the Topagoruk formation, lat. 69°12′30″ N., long. 156°47′ W., northern Alaska. Collected by M. L. Troyer, 1947.

Unfigured paratypes (USNM P4334) from 180–230 feet above the base of the Grandstand formation, on the north flank of the Awuna anticline (field sample 47A Tr 289), lat. 69°09′30″ N., long. 155°59′ W., northern Alaska. Collected by M. L. Troyer, 1947.

Unfigured paratypes (USNM P4335) from an outcrop 3,850 feet below the top of the Grandstand formation (field sample 47A Z 615 A), in a section on the north limb of the Kurupa anticline, from lat. 68°55′ N., long. 155°05′ W., to lat. 69° N., long. 155° W., along the Kurupa River, in the northern foothills of the Brooks Range, northern Alaska. Collected by J. H. Zumberge, 1947.

Unfigured paratypes (USNM P4336) from field sample 48A Dt 187, in marine zone of the Chandler formation, lat. 68°45′30″ N., long. 152°15′ W., northern Alaska. Collected by R. L. Detterman, 1948.

Unfigured paratypes (USNM P4337) from well cuttings at 450–460 feet in the Topagoruk formation, in South Barrow test well 2, at lat. 71°15′15″ N., long. 156°37′55″ W., south-southwest of Point Barrow, northern Alaska.

Verneuilinoides fischeri Tappan, new species

PLATE 66, FIGURES 23–28

Test large, free, flaring at the base, but comparatively narrow and elongate, sides nearly parallel in the later portion; chambers numerous, inflated, triserially arranged, increasing in proportional height as added; sutures distinct, depressed; wall finely agglutinated, surface smoothly finished; aperture loop shaped, at the base of the inner face of the final chamber.

Length of holotype 1.30 mm., breadth 0.39 mm. Paratypes range from 0.36 to 1.77 mm. in length.

REMARKS: This species occurs in the Seabee and Schrader Bluff formations of Turonian to Campanian age, and their equivalent zones in the Ignek formation.

Verneuilinoides fischeri, new species, differs from *Verneuilina parallela* Cushman from the Craie Blanche of France, in being longer, narrower and more tapering, in having relatively higher chambers, and in lacking the triangular section of true *Verneuilina*. *V. bearpawensis* (Wickenden) has more inflated and higher chambers and a more twisted test.

The species is named in honor of W. A. Fischer, geologist, U. S. Geological Survey, who collected some of the material containing this species.

TYPES AND OCCURRENCE: Holotype (USNM P4356), figured paratypes (USNM P4357a,b), and unfigured paratypes (USNM P4358) from the Upper Cretaceous part of the Ignek formation (field sample 46A L 66), at the base of the section exposed at the forks of the Ivishak and Sagavanirktok Rivers, at approximately lat. 69°30′ N., long. 148°30′ W., northeastern Alaska. Collected by E. H. Lathram, 1946.

Figured paratype (USNM P4359) from a core at 571–574 feet, unfigured paratype (USNM P4360) from a core at 500–510 feet, unfigured paratypes (USNM 4361) from a core at 589–602 feet, unfigured paratypes

(USNM P4362) from a core at 602–604 feet, and unfigured paratypes (USNM P4363) from a core at 829–839 feet, all from the Sentinel Hill member of the Schrader Bluff formation, in Sentinel Hill core test 1, at lat. 69°35′48″ N., long. 151°28′09″ W., on the banks of the Colville River, northwest of Umiat, northern Alaska.

Unfigured paratypes (USNM P4364) from a core at 1,351 feet in a marine zone of the Prince Creek formation, in Gubik test well 2, at lat. 69°25′10″ N., long. 151°27′26″ W., near the confluence of the Chandler and Colville Rivers, northern Alaska.

Figured paratype (USNM P4340) and unfigured paratypes (USNM P4341) from field sample 46A Fi 80A, in the Seabee formation (Turonian), taken one mile east of Wolf Creek test well 2, in the area of the Wolf Creek anticline, at lat. 69°24′32″ N., long. 153°31′25″ W., northern Alaska. Collected by W. A. Fischer, 1946.

Figured paratype (USNM P4342) and unfigured paratypes (USNM P4343) from field sample 46A Gr 98, lower part of the Ignek formation, on the Ivishak River, at lat. 69°20′40″N., long. 148°10′50″ W., northern Alaska. Collected by George Gryc, 1946.

Unfigured paratypes (USNM P4346) from field sample 47A St 25, from 2,570 feet below the top of the Sentinel Hill member of the Schrader Bluff formation, on the north bank of the Colville River, about 8 miles east-northeast of Umiat, at lat. 69°25′ N., long. 151°48′ W., about 7½ miles southwest of the junction of the Chandler and Colville Rivers, in the northern foothills of the Brooks Range, northern Alaska. Collected by Karl Stefansson, 1947.

Verneuilinoides tailleuri Tappan, new species

PLATE 66, FIGURES 19–22

Test free, relatively narrow, elongate, sides nearly parallel; chambers numerous, low, triserially arranged, somewhat inflated; sutures distinct, depressed, horizontal; wall finely agglutinated; aperture a low arch at the base of the final chamber.

Length of holotype 0.58 mm., breadth 0.18 mm. Paratypes range from 0.34 to 0.55 mm. in length.

REMARKS: *Verneuilinoides tailleuri*, new species, differs from *V. borealis*, new species, in being smaller and narrower, with nearly parallel sides, and in having lower, more numerous, and more closely appressed chambers and nearly horizontal sutures. It differs from *Tritaxia spiritensis prolongata* Stelck and Wall in lacking the terminal aperture and in having lower and more closely appressed chambers.

V. tailleuri is restricted to the Fortress Mountain formation. The specific name is in honor of I. L. Tailleur, geologist, U. S. Geological Survey, who collected some of the outcrop material containing this species.

TYPES AND OCCURRENCE: Holotype (USNM P4367), figured paratype (USNM P4368), and unfigured paratypes (USNM P4369) from 5,500 to 6,000 feet above the base of the Fortress Mountain formation (field sample 49A Tr 565), on Castle Creek, south-southwest of Castle Mountain, at lat. 68°32′05″ N., long. 152°49′ W., in the southern foothills of the Brooks Range, northern Alaska. Collected by I. L. Tailleur, 1949.

Unfigured paratype (USNM P 4370) from the Fortress Mountain formation (field sample 49A Pa 84), along Fortress Creek, tributary to the Ayiyak River, northwest of Fortress Mountain, at lat. 68°35′20″ N., long. 153°11′30″ W., in the southern foothills of the Brooks Range, northern Alaska. Collected by W. W. Patton, Jr., 1949.

Figured paratype (USNM P4365) and unfigured paratypes (USNM P4366) from the Fortress Mountain formation (field sample 49A Tr 662), from a cut bank on the east side of a small tributary that enters Kiruktagiak River from the south, about 1,000 feet upstream from their confluence, at lat. 68°37′ N., long. 152°42′ W., in the southern foothills of the Brooks Range, northern Alaska. Collected by I. L. Tailleur, 1949.

Unfigured paratype (USNM P4371) from the Fortress Mountain formation (field sample 49A Pa 436), on Castle Creek, 2.9 miles airline south-southwest of Castle Mountain, at lat. 68°32′30″ N., long. 152°51′30″ W., in the southern foothills of the Brooks Range, northern Alaska. Collected by W. W. Patton, Jr., 1949.

Unfigured paratype (USNM P4372) from the Fortress Mountain formation (field sample 49A Pa 571), on Castle Creek, about 2¾ miles southwest of Castle Mountain, at lat. 68°32′45″ N., long, 152°51′30″ W., in southern foothills of the Brooks Range, northern Alaska. Collected by W. W. Patton, Jr., 1949.

Figured paratype (USNM P4373) and unfigured paratypes (USNM P4374) from field sample 49A Pa 594, in a section from 1,150 to 1,750 feet above the base of the Fortress Mountain formation, on the Kiruktagiak River, west of Castle Mountain, at lat. 68°35′ N., long. 152°54′ W., in the southern foothills of the Brooks Range, northern Alaska. Collected by W. W. Patton, Jr., 1949.

Family Valvulinidae Cushman, 1927

Genus Arenobulimina Cushman, 1927

Arenobulimina paynei Tappan, new species

PLATE 67, FIGURES 1–4

Test free, flaring, early portion triserial, later with four chambers to a whorl; chambers much inflated, although some specimens have been crushed in preservation, increasing rapidly in size; sutures distinct and much constricted; wall finely agglutinated, but some of the paratypes are represented only by pyritic casts, a common method of preservation in these strata; aperture a low arch at the inner margin of the final chamber.

Length of holotype 0.36 mm., breadth 0.21 mm. Paratypes range in length from 0.18 to 0.55 mm.

REMARKS: This species differs from *Arenobulimina chapmani* Cushman from the Gault of England in being more flaring, about one-third as large, and with more

inflated and fewer chambers to each whorl. It occurs in the Grandstand and Topagoruk formations.

This species is named in honor of T. G. Payne, geologist formerly with the U. S. Geological Survey, in recognition of his work on the stratigraphy of the Cretaceous strata of Alaska.

Types and occurrence: Holotype (USNM P 4375 from well cuttings at 4,140–4,150 feet, unfigured paratype (USNM P4376) from well cuttings at 4,150–4,160 feet, unfigured paratypes (USNM P4377) from well cuttings at 3,160–3,170 feet, unfigured paratypes (USNM P4378) from well cuttings at 4,460–4,470 feet, all in the Topagoruk formation, in Umiat test well 1, west of Umiat, at lat. 69°23′52″ N., long. 152°19′45″ W., in the northern foothills of the Brooks Range, northern Alaska.

Figured paratype (USNM P4379) and unfigured paratypes (USNM P4380) from a core at 602–609 feet in the Grandstand formation; unfigured paratypes (USNM P4381) from well cuttings at 1,560–1,570 feet, unfigured paratype (USNM P4382) from well cuttings at 2,850–2,860 feet, unfigured paratype (USNM P4383) from well cuttings at 2,900–2,910 feet, figured paratypes (USNM P4384a,b) from well cuttings at 2,980–2,990 feet, and unfigured paratype (USNM P4385) from well cuttings at 4,580–4,590 feet, all in the Topagoruk formation; all in Umiat test well 2, at lat. 69°23′04″ N., long. 152°05′01″ W., north of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Arenobulimina torula Tappan, new species

Plate 67, Figures 5–7

Test free, elongate, flaring from the pointed base, rounded in section; chambers numerous, low and triserial in the early portion, later becoming higher and narrower with four chambers to a whorl, the chambers lying somewhat obliquely; sutures distinct, flush, oblique, somewhat darker in color than the remainder of the test; wall finely arenaceous, surface smoothly finished, specimens commonly crushed in various ways in preservation; aperture an arch at the base of the inner face of the final chamber.

Length of holotype 0.62 mm., breadth 0.36 mm. Paratypes range from 0.16 to 0.68 mm. in length.

Remarks: *Arenobulimina torula*, new species, differs from *A. chapmani* Cushman in being slightly larger, and in having broader, lower, and more inflated chambers, and in being more finely arenaceous with a more smoothly finished surface.

This species occurs in the Ayiyak member of the Seabee formation and in the Ignek formation.

Types and occurrence: Holotype (USNM P4393) from the Ignek formation, on the Shaviovik anticline, seismograph party 144, line 4–53, shot hole 6, at 50–100 feet, at lat. 69°34′24″ N., long. 147°33′35″ W., at the eastern end of the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratype (USNM P4394) from a depth of 50–100 feet and unfigured paratypes (USNM P4395) from a depth of 100–150 feet, all in the Ignek formation, seismograph party 144, line 8–53, shot hole 4, along the Shaviovik anticline, at lat. 69°34′26″ N., long. 147°43′03″ W., at the eastern end of the northern foothills of the Brooks Range, northern Alaska.

Figured paratypes (USNM P4396a,b) and unfigured paratypes (USNM P4397) from the Ignek formation (field sample 46A L 66), at the base of the section exposed at the confluence of the Ivishak and Sagavanirktok Rivers, at approximately lat. 69°30′ N., long. 148°30′ W., in northern Alaska. Collected by E. H. Lathram, 1946.

Unfigured paratypes (USNM P4398) from the Ayiyak member of the Seabee formation (field sample 47A Wb 35), on the Nanushuk River, at lat. 68°45′ N., long. 150°43′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by E. J. Webber, 1947.

Unfigured paratypes (USNM P4399) from the Ayiyak member of the Seabee formation, in Umiat seismograph shot point 13, at a depth of 25 feet, at lat. 69°24′29.4″ N., long. 152°05′19.8″ W., near Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratypes (USNM P4400) from the Seabee formation, at 561–571 feet, in Umiat test well 11, lat. 69°24′29″ N., long. 152°05′58″ W., north of Umiat, northern Alaska.

Genus Dorothia Plummer, 1931

Dorothia chandlerensis Tappan, new species

Plate 66, Figures 29, 30

Test free, narrow, elongate, sides nearly parallel; early chambers in a whorl at the base forming a somewhat inflated knob, followed by seven or eight pairs of biserially arranged, somewhat compressed chambers all of nearly equal size, relatively low and broad; sutures obscure in the early portion, distinct and depressed in the biserial portion; wall finely arenaceous, roughly finished; aperture a low arch at the base of the final chamber.

Length of holotype 0.62 mm., breadth 0.18 mm. Paratypes range from 0.39 to 0.99 mm. in length.

Remarks: *Dorothia chandlerensis*, new species, differs from *D. filiformis* (Berthelin) in the more bulbous early portion, the broader parallel-sided biserial portion, and more roughly finished wall.

It occurs in the Torok and Oumalik formations.

Types and occurrence: Holotype (USNM P4401) and unfigured paratypes (USNM P4402) from field sample 48A Dt 120, in the Torok formation, 4300 feet below the top of the section exposed in Tuktu Bluff, and unfigured paratypes (USNM P4403) from field sample 48A Dt 121, taken 80 feet lower, in the Tuktu Bluff on the Chandler River, at lat. 68°41′ N., long. 152°15′ W., in the southern foothills section of the Brooks Range, northern Alaska. Collected by R. L. Detterman, 1948.

Figured paratype (USNM P4404) from well cuttings at 5,150–5,160 feet in the Oumalik formation, in

Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Unfigured paratypes (USNM P4405) from field sample 49A Tr 685, in the Torok formation, on the south limb of the Ayiyak anticlinorium on the Kiruktagiak River, north of Castle Mountain, at lat. 68°39′15″ N., long. 152°43′ W., in the southern foothills of the Brooks Range, northern Alaska. Collected by I. L. Tailleur, 1949.

Unfigured paratype (USNM P4406) from field sample 49A Tr 756, in the Torok formation, on Okok Creek, tributary to the Okpikruak River, at lat. 68°42′30″ N., long. 153°35′ W., in the Castle Mountain area in the southern foothills of the Brooks Range, northern Alaska. Collected by I. L. Tailleur, 1949.

Family Rzehakinidae Cushman, 1933

The genera here included were in part previously placed in the subfamily Rzehakininae, family Siliciniidae. However, the type genus of the family, *Silicina* Bornemann 1874, is unrecognizable as based on its type species, *Involutina polymorpha* Terquem, 1863. Of the three type specimens of Terquem in the Museum National d'Histoire Naturelle, Paris, examined by Alfred R. Loeblich, Jr., and the writer, one is a fragment of a *Reophax* and the other two are indeterminate fragments. Hence the species and the genus for which it serves as type species are unrecognizable and are here suppressed. Of the three genera placed by Cushman in the subfamily Silicininae Cushman (1933, p. 143) (not Involutininae as proposed by Thalmann, 1935, p. 715) *Silicina* is thus unrecognizable; *Involutina* Terquem, 1862, was shown (Loeblich and Tappan, 1954, p. 308) to be an agglutinated form (including species previously referred to *Ammodiscus*); and *Problematina* Bornemann is calcareous, not related to these siliceous genera.

Because *Silicina* is invalid, the family name has no validity, as families (and subfamilies) must be based on a valid genus included in them. For this reason the subfamily Silicininae of Earland (1933, p. 91) also was invalid, as he originally considered it a subfamily of the Lituolidae, including only *Rzehakina*, *Silicosigmoilina* and *Miliammina*, and not including *Silicina*, which must be included if the subfamily name be based on its name. Thalmann (1935, p. 715) was therefore in error in proposing the subfamily Involutininae for the subfamily Silicininae Cushman, 1933 (not Earland, 1933). Cushman included the genus *Silicina* Bornemann in his subfamily and therefore his usage was valid, whereas Earland did not include that genus and his usage was not valid.

The name Involutininae Thalmann, 1935 (not Cushman, 1940, as was erroneously cited by Loeblich and Tappan, 1954, p. 308), with the type genus *Involutina* Terquem, 1862, must therefore be removed to the family Tolypamminidae (see Loeblich and Tappan, 1954, p. 308).

Sigal (1952, p. 159) restricted the Involutinidae to include only *Silicina*, *Problematina*, and *Involutina*, and placed the family under the suborder Biloculinidea. He then (1952, p. 208) named an "appendice-famille" Paramiliolidae to include the chambered genera, i. e., *Rzehakina*, *Silicosigmoilina*, *Miliammina*, and *Spirolocammina*, and placed this "family" in the suborder Pluriloculinidea, superfamily Miliolidea. However, the family "Paramiliolidae" is also invalid, as there is no genus "*Paramiliola*" upon which it can be based.

Therefore as the Involutininae is based on a genus belonging elsewhere, as the Siliciniidae is based on a genus which is unrecognizable, and as the "Paramiliolidae" is not based on any genus, the next family or subfamily name available (these are considered of equal rank for purposes of priority, according to the Rules of Nomenclature) would be the Rzehakininae Cushman, 1933, which is here elevated to family rank.

This family now includes *Rzehakina* Cushman, 1927, *Silicosigmoilina* Cushman and Church, 1929, *Miliammina* Heron-Allen and Earland, 1930, *Spiroiocammina* Earland, 1934, *Bramletteia* Israelsky, 1951, *Triloculareena* Loeblich and Tappan, 1955, and the new genus *Psamminopelta*, here described.

The Rzehakinidae includes siliceous or arenaceous genera, insoluble in acid, which are in large part isomorphs of the calcareous imperforate Miliolidae.

Genus Miliammina Heron-Allen and Earland, 1930

Miliammina awunensis Tappan, new species

PLATE 67, FIGURES 19–21

Test free, elongate, flattened, ovate in outline, quinqueloculine in plan; chambers narrow, elongate, each a half coil in length, of equal diameter throughout length; sutures distinct, depressed; wall finely agglutinated, surface smoothly finished; aperture a simple opening at the end of the tubular chamber.

Length of holotype 0.44 mm., breadth 0.26 mm. Paratypes range from 0.23 to 0.65 mm. in length.

REMARKS: Specimens of this species are commonly distorted in preservation and may be crushed at varying angles, so that the test may assume variable outlines.

Miliammina awunensis, new species, differs from *M. manitobensis* Wickenden in having narrower chambers, of even diameter throughout, and in being more finely agglutinated and smoothly finished. It differs from *M. valdensis* Bartenstein and Brand in being somewhat larger with thicker chambers.

It occurs in the Gransdtand and Topagoruk formations and in marine zones of the equivalent Chandler formation.

TYPES AND OCCURRENCE: Holotype (USNM P4407) from residual soil of brackish or marine tongues in the Chandler formation, on the south flank of the Awuna syncline (field sample 47A Wh 623), at lat. 69°03′18″ N., long. 156°02′30″ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by C. L. Whittington, 1947.

Unfigured paratypes (USNM P4408) from field sample 47A Wh 688, in residual soil of the Grandstand formation, on the south flank of the Awuna anticline, at lat. 69°02′48″ N., long. 155°59′30″ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by C. L. Whittington, 1947.

Figured paratype (USNM P4409) and unfigured paratypes (USNM P4410) from field sample 47A Wh 655, in residual soil of marine or brackish tongues in the Chandler formation, on the south flank of the Awuna anticline, at lat. 69°06′48″ N., long. 155°58′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by C. L. Whittington, 1947.

Unfigured paratypes (USNM P4411) from field sample 47A Tr 293, from a marine zone in the Chandler formation on the north flank of the Awuna anticline, at lat. 69°09′30″ N., long. 155°59′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by M. L. Troyer, 1947.

Unfigured paratypes (USNM P4412) from field sample 47A Tm 13, bed 12, 60 feet below the top of exposed 100-foot section of the Cretaceous, probably equivalent to the lower part of the Nanushuk group of the eastern areas, on the south limb of a syncline, on the west bank of the Utukok River, at approximately lat. 69°13′ N., long. 160°38′ W., about 70 miles east-northeast of Cape Beaufort, in the northern foothills of the Brooks Range, northern Alaska. Collected by R. M. Thompson, 1947.

Unfigured paratypes (USNM P4413) from field sample 47A Z 604, in the Grandstand formation, on the north limb of the Kurupa anticline, in a section from lat. 68°55′ N., long. 155°05′ W., to lat. 69°00′ N., long. 155° W., along the Kurupa River, west-southwest of Umiat, in the northern foothills of the Brooks Range, northern Alaska. Collected by J. H. Zumberge, 1947.

Unfigured paratype (USNM P4414) from a core at 432–439 feet in the Grandstand formation, in Umiat test well 3, at lat. 69°23′16″ N., long. 152°05′14″ W., north of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Figured paratype (USNM P4415) and unfigured paratypes (USNM P4416) from a core at 256–264 feet, in the Grandstand formation in Skull Cliff core test 1, at lat. 70°55′ N., long. 157°38′ W., between Point Barrow and Point Franklin, northern Alaska.

Unfigured paratypes (USNM P4417) from a core at 443–444 feet in the Grandstand formation, in Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Unfigured paratypes (USNM P4418) from a core at 459–469 feet in the Topagoruk formation, in South Barrow test well 2, at lat. 71°15′15″ N., long. 156°37′55″ W., south-southwest of Point Barrow, northern Alaska.

Miliammina ischnia Tappan, new species

PLATE 67, FIGURES 25, 26

Test free, small, narrow, elongate, sides subparallel, quinqueloculine in section; chambers narrow, elongate, a half coil in length; sutures distinct, depressed; wall finely agglutinated, surface smoothly finished; aperture at the open end of the final chamber.

Length of holotype 0.36 mm., breadth 0.10 mm.

REMARKS: *Miliammina ischnia*, new species, differs from *M. manitobensis* Wickenden in being smaller and comparatively narrower and more elongate. It differs from *Miliammina awunensis*, new species, in being narrower with nearly parallel sides, rather than ovate in outline. *Miliolina gramen* Friedberg is similar in general appearance, but is two to three times at large.

This species is found in the Grandstand formation.

TYPES AND OCCURRENCE: Holotype USNM P4419) and unfigured paratypes (USNM P4420) from a core at 1,910-1,920 feet and figured paratype (USNM P4421) and unfigured paratypes (USNM P4422) from a core at 1,693–1,703 feet, both in the Grandstand formation, in Umiat test well 1, at lat. 69°23′52″ N., long. 152°19′45″ W., west of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratypes (USNM P4423) from a core at 432–439 feet in the Grandstand formation, in Umiat test well 3, lat. 69°23′16″ N., long. 152°05′14″ W., north of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Genus Psamminopelta Tappan, new genus

TYPE SPECIES: *Psamminopelta bowsheri* Tappan, new species. (Derivation: *psamminos*, Gr., of sand + *pelte*, Gr., f., small, light shield; gender, feminine.)

Test free, flattened, consisting of proloculus and tubular, planispirally coiled chambers, each a half coil in length, and only very slightly overlapping earlier whorls; wall agglutinated with siliceous cement, insoluble in hydrochloric acid; aperture at the open end of the tubular chamber, without a tooth.

REMARKS: *Psamminopelta*, new genus, differs from *Rzehakina* Cushman in having chambers exactly half a coil in length, so that the test is symmetrical about the vertical axis rather than having a sigmoid vertical axis. It differs from *Spirolocammina* Earland in having a perfectly planispiral development, and lacking the slightly sigmoid plan of chamber arrangement, as seen in horizontal section.

Miliammina Heron-Allen and Earland has a quinqueloculine rather than planispiral development, and *Triloculariena* Loeblich and Tappan is triloculine in section.

Psamminopelta bowsheri Tappan, new species

PLATE 67, FIGURES 11–18, 22–24

Test free, ovate in outline, flattened, consisting of long, narrow and tubular planispirally arranged chambers, each a half coil in length, and only very slightly overlapping earlier coils; sutures depressed; wall finely agglutinated, smoothly finished, with siliceous cement, insoluble in acid, commonly crushed and flattened in preservation; aperture at the open end of the tubular chamber, commonly appearing elongate because of compression of the test, without a tooth.

Length of holotype 0.83 mm., breadth 0.57 mm., thickness 0.05 mm. Paratypes range from 0.29 to 0.91 mm. in length.

Remarks: *Psamminopelta bowsheri*, new species, differs from *Massilina texasensis* Cushman in the narrower chambers, planispiral coiling, relatively broader test, and the agglutinated wall, which is insoluble in acid.

The species occurs in the Grandstand, Topagoruk, Tuktu, and upper part of the Torok formations and in marine zones of the equivalent Chandler formation. It is named in honor of A. L. Bowsher, geologist, U. S. Geological Survey.

Types and occurrence: Holotype (USNM P4424) from a core at 256–264 feet in the Grandstand formation, in Skull Cliff core test 1, at lat. 70°55′ N., long. 157°38′ W., between Point Barrow and Point Franklin, northern Alaska.

Unfigured paratypes (USNM P4425) from a core at 438–443 feet, in the Grandstand formation, figured paratype (USNM P4426) from a core at 1,020–1,030 feet and unfigured paratypes (USNM P4427) from a core at 1,247–1,267 feet in the Topagoruk formation, all in Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Unfigured paratype (USNM P4428) from well cuttings at 470–480 feet in the Grandstand formation, in Simpson core test 10, at lat. 70°57′34″ N., long. 155°17′27″ W., near Cape Simpson, northern Alaska.

Unfigured paratypes (USNM P4468) from a core at 1,424–1,434 feet, figured paratype (USNM P4429) from a core at 1,615–1,620 feet, and figured paratypes (USNM P4430a–d) and unfigured paratypes (USNM P4431) from a core at 1,810–1,816 feet, all from the Grandstand formation; and unfigured paratypes (USNM P4432) from well cuttings at 3,970–3,980 feet and unfigured paratype (USNM P4433) from well cuttings at 4,790–4,800 feet in the Topagoruk formation; all in Umiat test well 1, at lat. 69°23′52″ N., long. 152°19′45″ W., west of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Figured paratype (USNM P4434) from residual soil of the Grandstand formation (field sample 47A Wh 688), at lat. 69°02′48″ N., long. 155°59′30″ W.; unfigured paratypes (USNM P4435) from residual soil of marine zone in the Chandler formation (field sample 47A Wh 648), at lat. 69°06′12″ N., long. 155°57′ W.; figured paratype (USNM P4436) and unfigured paratype (USNM P4437) from field sample 47A Wh 654, a residual soil sample of marine tongues taken 610–650 feet above the base of the Chandler formation, at lat. 69°06′48″ N., long. 155°58′ W.; and unfigured paratype (USNM P4438) from residual soil of marine zone in the Chandler formation (field sample 47A Wh 671), at lat. 69°07′18″ N., long. 155°58′18″ W.; all from the south flank of the Awuna anticline, in the northern foothills of the Brooks Range, northern Alaska. Collected by C. L. Whittington, 1947.

Unfigured paratypes (USNM P4439) from marine zone in the Chandler formation (field sample 48A Dt 249), from the Chandler River area, at lat. 68°55′ N., long. 151°50′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by R. L. Detterman, 1948.

Figured paratype (USNM P4462) and unfigured paratypes (USNM P4463) from field sample 47A Tr 253, in the Kukpowruk formation, on the north flank of the Awuna anticline, at lat. 69°09′30″ N., long. 155°59′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by M. L. Troyer, 1947.

Unfigured paratypes (USNM P4464) from field sample 47A Wh 594, residual soil sample of the Grandstand formation, on the south flank of the Kigalik anticline, lat. 69°17′48″ N., long. 155°51′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by C. L. Whittington, 1947.

Unfigured paratype (USNM P4465), from seismograph party 47, line 14 A–48, shot hole 45, at 110–120 feet, in the Grandstand formation, at lat. 71°16′20″ N., long. 156°45′07″ W., in the Arctic Coastal Plain of northern Alaska.

Unfigured paratype (USNM P4466) from the Grandstand formation (field sample 47A Dt 227) from 4¾ miles airline upstream from the mouth of Fossil Creek, tributary to the Colville River, at approximately lat. 69°19′20″ N., long. 152°28′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by R. L. Detterman, 1947.

Unfigured paratype (USNM P4467) from 81 feet below the top of the Tuktu formation (field sample 47A Z 604) and unfigured paratypes (USNM P4445) from 70 feet above the base of the Tuktu formation (field sample 47A Z 608), on the north limb of the Kurupa anticline, in a section from lat. 68°55′ N., long. 155°05′ W., to lat. 69°N., long. 155° W., along the Kurupa River, in the northern foothills of the Brooks Range, northern Alaska. Collected by J. H. Zumberge, 1947.

Figured paratype (USNM P4443) and unfigured paratypes (USNM P4444) from field sample 47A Wh 199, in the upper part of the Torok formation, equivalent to the Topagoruk formation of the subsurface, 75–100 feet above the base of the section exposed on Quartzite Creek, Awuna River region, at lat. 69°13′ N., long. 157°02′18″ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by C. L. Whittington, 1947.

Unfigured paratypes (USNM P4447) from field sample 47A Ba 50, in a marine zone, in an unnamed, dominantly nonmarine upper unit of the Nanushuk group of the western area and equivalent to the Corwin formation of the Cape Lisburne Peninsula, 1,400 feet below the top of a 3,700-foot section of intermittent exposures along the north bank of the Utukok River, at approximately lat. 69°07′30″ N., long. 160°54′ W., about 70 miles east of Cape Beaufort, in the northern foothills of the Brooks Range, northern Alaska. Collected by W. L. Barksdale, 1947.

Unfigured paratypes (USNM P4448) from a core at 472–481 feet in the Grandstand formation, in Umiat test well 3, at lat. 69°23′16″ N., long. 152°05′14″ W., north of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratype (USNM P4449) from well cuttings at 1,090–1,100 feet and unfigured paratype (USNM P4450) from well cuttings at 1,180–1,190 feet in the Topagoruk formation, in South Barrow test well 1, at lat. 71°19′12″ N., long. 156°42′15″ W., southwest of Point Barrow, northern Alaska.

Unfigured paratype (USNM P4451) from well cuttings at 750–760 feet in the Topagoruk formation, in South Barrow test well 2, at lat. 71°15′15″ N., long. 156°37′55″ W., south-southwest of Point Barrow, northern Alaska.

Psamminopelta subcircularis Tappan, new species

PLATE 67, FIGURES 8–10

Test free, discoidal, planispiral, each chamber a half coil in length, chambers very narrow and elongate, nearly circular in section; sutures distinct, depressed; wall finely agglutinated, smoothly finished; aperture at the end of the last tubular chamber, no tooth visible.

Length of holotype 0.31 mm., greatest breadth 0.26 mm., thickness 0.04 mm. Paratypes range from 0.18 to 0.34 mm. in length.

REMARKS: *Psamminopelta subcircularis*, new species, differs from *Miliammina manitobensis* Wickenden in being much smaller, about one fourth as large, in being discoidal rather than fusuline in shape, and in lacking the quinqueloculine development of *Miliammina*. It somewhat resembles *Massilina glutinosa* Cushman and Cahill, but is about one-half as large, with narrower chambers and more nearly circular outline, planispiral development, and arenaceous wall, insoluble in acid.

The species occurs in the Grandstand and Topagoruk formations.

TYPES AND OCCURRENCE: Holotype (USNM P4452) and figured paratype (USNM P4453) from a core at 361–366 feet in the Grandstand formation, in Umiat test well 3, at lat. 69°23′16″ N., long. 152°05′14″ W., north of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Figured paratype (USNM P4454) and unfigured paratype (USNM P4455) from a core at 499–509 feet, unfigured paratype (USNM P4456) from a core at 522–524 feet, unfigured paratypes (USNM P4457) from a core at 770–780 feet, all from the Grandstand formation; and unfigured paratype (USNM P4458) from well cuttings at 4,010–4,020 feet in the Topagoruk formation; all in Umiat test well 2, at lat. 69°23′04″ N., long. 152°05′01″ W., north of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratypes (USNM P4459) from a core at 1,424–1,434 feet, unfigured paratypes (USNM P4460) from a core at 1,693–1,703 feet, and unfigured paratypes (USNM P4461) from a core at 1,713–1,723 feet, all from the Grandstand formation, in Umiat test well 1, at lat. 69°23′52″ N., long. 152°19′45″ W., west of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Family Trochamminidae Schwager, 1877

Genus Trochammina Parker and Jones, 1859

Trochammina eilete Tappan, new species

PLATE 68, FIGURES 1, 2

Test free, discoidal, trochoid but with a flattened spire, periphery rounded; chambers numerous, about 10 to 14 in the final whorl of adult specimens, of greater height than breadth and appearing cuneate in side view; sutures distinct, thickened, somewhat depressed, radiate; wall finely agglutinated, with considerable cement, surface smoothly finished; aperture a low arch at the base of the final chamber face, against the periphery of the previous whorl.

Greatest diameter of holotype 0.52 mm., thickness 0.17 mm. Paratypes range from 0.21 to 0.68 mm. in diameter.

REMARKS: *Trochammina eilete*, new species, differs from *T. sablei* Tappan from the Jurassic in being about twice as large, in having many more chambers per whorl, and in the chambers being wedge shaped rather than inflated and subglobular. This species is characteristic of the Torok formation and the equivalent Fortress Mountain formation.

TYPES AND OCCURRENCE: Holotype (USNM P4483) and unfigured paratypes (USNM P4484) from field sample 49A Ch 45 and unfigured paratypes (USNM P4485) from field sample 49A Ch 44, both taken 180 feet (approximate) below top of the Torok formation in Ravine Basin, Kukpowruk River area, at lat. 68°46′30″ N., long. 163°07′ W., in northwestern Alaska. Collected by R. M. Chapman, 1949.

Figured paratype (USNM P4487) and unfigured paratype (USNM P4488) from the Fortress Mountain formation, in a section 1,150–1,750 feet above the base (field sample 49A Pa 593), on the Kiruktagiak River, west of Castle Mountain, at lat. 68°35′ N., long. 152°54′ W., in the southern foothills of the Brooks Range, northern Alaska. Collected by W. W. Patton, Jr., 1949.

Unfigured paratypes (USNM P4489) from 5,500 to 6,000 feet above the base of the Fortress Mountain formation (field sample 49A Tr 562), on Castle Creek, south-southwest of Castle Mountain, at lat. 68°32′05″ N., long. 152°49′ W., in the southern foothills of the Brooks Range, north Alaska. Collected by I. L. Tailleur, 1949.

Unfigured paratypes (USNM P4482) from the Torok formation (field sample 49A Tr 695), on the south limb of the Ayiyak anticlinorium, on the Kiruktagiak River, due north of Castle Mountain, at lat. 68°38′40″ N., long. 152°44′ W., in the southern foothills of the Brooks Range, northern Alaska. Collected by I. L. Tailleur, 1949.

Trochammina stefanssoni Tappan, new species

PLATE 67, FIGURES 30–33

Test free, trochoid, low spired, periphery rounded; all chambers of the approximately two whorls visible dorsally, only the nine of the final whorl visible on the umbilicate ventral side, chambers increasing rapidly in size, early ones subglobular, later cuneate in side view; sutures distinct, depressed, radial; wall very finely arenaceous, with considerable cement and smoothly finished, all specimens crushed and distorted in preservation; aperture an arch at the base of the final chamber face, against the previous whorl on the periphery.

Greatest diameter of holotype 0.55 mm. Paratypes range from 0.31 to 0.62 mm. in diameter.

REMARKS: *Trochammina stefanssoni*, new species, differs from *T. diagonis* (Carsey) in having more chambers to each whorl and in the chambers being cuneate rather than rounded and inflated. It is also more finely arenaceous and more smoothly finished.

This species has been found only in the Sentinel Hill member of the Schrader Bluff formation (Upper Cretaceous). The specific name is in honor of Karl Stefansson, geologist, formerly of the U. S. Geological Survey.

TYPES AND OCCURRENCE: Holotype (USNM P4490) and unfigured paratypes (USNM P4491) from a core at 475–476 feet, figured paratypes (USNM P4492a–c) and unfigured paratypes (USNM P4493) from a core at 478–480 feet, and unfigured paratypes (USNM P4494) from a core at 579–589 feet, all from the Sentinel Hill member of the Schrader Bluff formation, in Sentinel Hill core test 1, at lat. 69°35′48″ N., long. 151°28′09″ W., on the west bank of the Colville River, Arctic Coastal Plain, northern Alaska.

Trochammina umiatensis Tappan, new species

PLATE 67, FIGURES 27–29

Test free, trochoid, relatively high spired, periphery lobulate and rounded; chambers inflated and subglobular, few in number, increasing rapidly in size, only four or rarely five in each whorl; sutures distinct, depressed, radial; wall finely to coarsely agglutinated, roughly finished; aperture ventral, a slit at the base of the final chamber face.

Greatest diameter of holotype 0.68 mm., thickness 0.29 mm. Paratypes range from 0.29 to 0.81 mm. in diameter.

REMARKS: *Trochammina umiatensis*, new species, differs from *T. globigeriniformis* (Parker and Jones) in having more chambers per whorl, commonly four instead of the three of *T. globigeriniformis*, in being nearly three times as large, and in having a better developed and higher spire and a greater increase in chamber size.

TYPES AND OCCURRENCE: Holotype (USNM P4495) from well cuttings at 735–740 feet in the Grandstand formation, in Umiat test well 2, at lat. 69°23′04″ N., long. 152°05′01″ W., north of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratypes (USNM P4500) from a core at 1,615–1,625 feet and unfigured paratype (USNM P4501) from a core at 1,625–1,635 feet, both in the Grandstand formation, in Umiat test well 1, at lat. 69°23′52″ N., long. 152°19′45″ W., west of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Figured paratypes (USNM P4502a–b) from a core at 1,130–1,133 feet, unfigured paratypes (USNM P4503) from a core at 1,183–1,186 feet, and unfigured paratypes (USNM P4504) from well cuttings at 1,190–1,195 feet, all in the Grandstand formation, in Umiat test well 8, at lat. 69°23′59″ N., long. 152°06′56″ W., north of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Trochammina whittingtoni Tappan, new species

PLATE 68, FIGURES 3–6

Test free, trochoid, much compressed; chambers numerous, increasing gradually in size, eight to nine in the final whorl; sutures slightly depressed, radial; wall finely agglutinated, probably with a "chitinous" base as all specimens are laterally crushed in preservation and of a brownish color, with chambers collapsed centrally; aperture obscured by the lateral compression of the test.

Greatest diameter of holotype 0.49 mm. Paratypes range from 0.26 to 0.73 mm. in diameter.

REMARKS: This species differs from *T. diagonis* (Carsey) in having more chambers per whorl and having a characteristic brownish color and fine-grained wall, with its usual lateral compression.

The species occurs in the Seabee and Schrader Bluff formations of the Upper Cretaceous. It is named in honor of C. L. Whittington, geologist, U. S. Geological Survey.

TYPES AND OCCURRENCE: Holotype (USNM P4505), figured paratype (USNM P4506), and unfigured paratypes (USNM P4507), all from the Seabee formation (field sample 47A Wh 295), taken 541–545 feet below the top, on September Creek, Knifeblade area, between the Kigalik and Awuna Rivers, at lat. 69°11′ N., long. 154°34′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by C. L. Whittington, 1947.

Figured paratype (USNM P4508) and unfigured paratype (USNM P4509) taken 20 feet above the base of the Seabee formation (field sample 47A Dt 80) and unfigured paratypes (USNM P4510) taken 210 feet above the base of the Seabee formation (field sample 47A Dt 125), all from the vicinity of the Colville River, west of Ninuluk Creek, at lat. 69°13′ N., long. 153°15′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by R. L. Detterman, 1947.

Unfigured paratypes (USNM P4511) taken 140–160 feet above the base of the Ayiyak member of the Seabee formation (field sample 48A Dt 377), at lat. 69°10′ N., long. 151°27′ W., and unfigured paratypes (USNM P4512) taken 990–1010 feet above the base of the Rogers Creek member of the Schrader Bluff formation (field sample 48A Dt 422), at lat. 69°14′ N., long.

151°25′ W., along the Chandler River, near the Schrader anticline, southeast of Umiat, in the northern foothills of the Brooks Range, northern Alaska. Collected by R. L. Detterman, 1948.

Unfigured paratypes (USNM P4513) taken 2,460 feet below the top of the Sentinel Hill member of the Schrader Bluff formation (field sample 47A St 30), on the north bank of the Colville River, about 7½ miles southwest of the confluence of the Chandler and Colville Rivers at lat. 69°25′ N., long. 151°48′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by Karl Stefansson, 1947.

Figured paratype (USNM P4514) and unfigured paratypes (USNM P4515) from a core at 609–615 feet, all from the Sentinel Hill member of the Schrader Bluff formation, in Sentinel Hill core test 1, at lat. 69°35′48″ N., long. 151°28′09″ W., on the west bank of the Colville River, Arctic Coastal Plain, northern Alaska.

Unfigured paratypes (USNM P4517) from a core at 499–509 feet and unfigured paratypes (USNM P4518) from a core at 519–529 feet, all from the Seabee formation, in Umiat test well 1, at lat. 69°23′52″ N., long. 152°19′45″ W., west of Umiat in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratypes (USNM P4519) from 1,290 feet below the top of the Seabee formation (field sample 47A Wb 172), along the Nanushuk River about 15 miles south of the confluence of the Nanushuk and Anaktuvuk Rivers, at approximately lat. 69°04′ N., long. 150°55′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by E. J. Webber, 1947.

Family Nodosariidae Schultze, 1854

Genus Marginulina d'Orbigny, 1826

Marginulina gatesi Tappan, new species

PLATE 68, FIGURES 7, 8

Test free, robust, early portion with a curved axis, but not a distinct coil, later uncoiled and rectilinear, rounded in section; chambers few in number, those of the curved early portion increasing very rapidly in size as added, later three or four chambers uncoiled and of more nearly equal size, considerably overlapping, inflated, final chamber about twice the height of the penultimate one; sutures distinct, somewhat constricted, radial in the early portion, nearly horizontal in the uncoiled part of the test; wall calcareous, finely perforate, surface ornamented with about 12 low and widely spaced vertical ribs; aperture radiate, terminal on the final chamber, eccentric, somewhat closer to the dorsal angle and slightly produced.

Length of holotype 0.52 mm., breadth 0.26 mm. Paratypes range from 0.36 to 0.68 mm. in length.

REMARKS: *Marginulina gatesi*, new species, differs from *M. radiata* Terquem in having fewer and wider spaced ribs and in these being vertical rather than crossing the chambers obliquely. The present species is also much more robust.

This species occurs in the Grandstand and Topagoruk formations. The specific name is in honor of G. L. Gates, chief of the Alaskan Geology Branch, U. S. Geological Survey.

TYPES AND OCCURRENCE: Holotype (USNM P4522) and unfigured paratypes (USNM P4523) from a core at 273–283 feet, unfigured paratypes (USNM P4524) from a core at 238–256 feet, unfigured paratypes (USNM P4525) from a core at 293–303 feet, unfigured paratype (USNM P4526) from a core at 338–348 feet, figured paratype (USNM P4527) and unfigured paratypes (USNM P4528) from a core at 523–533 feet, unfigured paratypes (USNM P4529) from a core at 900–910 feet, all in the Grandstand formation; and unfigured paratype (USNM P4530) from a core at 1,080–1,087 feet in the Topagoruk formation; all from Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Unfigured paratype (USNM P4531) from well cuttings at 410–420 feet in the Grandstand formation, in Simpson core test 10, at lat. 70°57′34″ N., long. 155° 17′27″ W., in the vicinity of Cape Simpson, northern Alaska.

Unfigured paratype (USNM P4532) from the Grandstand formation (field sample 47A Dt 228) taken about 4¾ miles airline upstream from the mouth of Fossil Creek, a small, north-flowing tributary to the Colville River, at lat. 69°19′20″ N., long. 152°28′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by R. L. Detterman, 1947.

Genus Dentalina d'Orbigny, 1826

Dentalina? dettermani Tappan, new species

PLATE 68, FIGURES 9–12

Test free, consisting of inflated somewhat elongate or ovate chambers, much constricted to a slender tubular neck at each end, and probably originally consisting of a number of these chambers uniserially arranged, but in an arcuate series as the chambers may be slightly asymmetrical, with the apertural neck eccentric; sutures consisting of greatly constricted neck, but chambers of all specimens observed have been broken apart at these constrictions; wall calcareous, finely perforate, hyaline, surface smooth or finely hispid; aperture at the end of the tubular neck, rounded.

Length of chamber of holotype 0.65 mm., breadth 0.34 mm. Paratypes range in chamber length from 0.29 to 0.55 mm.

REMARKS: The generic placement of this species is questioned, as no complete tests have been found, undoubtedly because of the fragile nature of the connecting necks between the inflated chambers. The asymmetry of the single chambers, their size range, and the invariable presence of a broken neck at one or both ends strongly suggest that these chambers represent an elongate, fragile *Dentalina*, whose chambers were isolated in preservation.

Superficially *D.? dettermani*, new species, resembles *Lagena hauteriviana* Bartenstein and Brand but differs in the presence of a connecting neck at both ends of

the inflated ovate chambers, their asymmetrical and more elongate outline, and the greater range in size, the smaller specimens possibly representing earlier formed chambers.

This species occurs in the Grandstand, Topagoruk, and Fortress Mountain formations. The specific name is in honor of R. L. Detterman, geologist, U. S. Geological Survey.

Types and occurrence: Holotype (USNM P4556), figured paratype (USNM P4557), and unfigured paratypes (USNM P4558), all from a core at 543–545 feet in the Grandstand formation, in Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Figured paratype (USNM P4559) from well cuttings at 5,730–5,740 feet and unfigured paratypes (USNM P4560) from well cuttings at 4,310–4,320 feet, all from the Topagoruk formation, in Umiat test well 2, at lat. 69°23′04″ N., long. 152°05′01″ W., north of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Figured paratype (USNM P4561) from the Fortress Mountain formation (field sample 49A Pa 94), on the north limb of Fortress Mountain syncline, along Fortress Creek, tributary to the Ayiyak River, southwest of Fortress Mountain, at lat. 68°35′ N., long. 153°10′ W., in the southern foothills of the Brooks Range, northern Alaska. Collected by W. W. Patton, Jr., 1949.

Genus Rectoglandulina Loeblich and Tappan, 1955

Rectoglandulina kirschneri Tappan, new species

Plate 68, Figures 17, 18

Test free, elongate, rectilinear, circular in section, chambers increasing gradually in size from the conical proloculus, early chambers closely appressed and overlapping, later more inflated and with less overlap, final chamber turbinate in appearance; sutures distinct, depressed, horizontal; wall calcareous, hyaline, finely perforate, surface smooth; aperture terminal, radiate, slightly produced on a neck.

Length of holotype 0.52 mm., breadth 0.23 mm. Paratypes range from 0.34 to 0.94 mm. in length.

Remarks: This species somewhat resembles *Glandulina elongata* Reuss, 1860, from the Upper Cretaceous (not *G. elongata* Bornemann, 1855) in general appearance but is about one-third as large and has a conical instead of a rounded proloculus.

The species has been found in the Grandstand, Topagoruk, and Oumalik formations. It is named in honor of C. A. Kirschner, geologist, formerly with U. S. Geological Survey.

Types and occurrence: Holotype (USNM P4546) from a core at 1,152–1,162 feet in the Topagoruk formation, in Point Barrow core test 1, at lat. 71°19′30″ N., long. 156°40′ W., southwest of Point Barrow, northern Alaska.

Unfigured paratype (USNM P4547) from a core at 555–565 feet in the Grandstand formation and figured paratype (USNM P4548) from well cuttings at 4,870–4,880 feet in the Oumalik formation, both in Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Unfigured paratype (USNM P4549) from a core at 1,625–1,630 feet in the Grandstand formation, in Umiat test well 1, at lat. 69°23′52″ N., long. 152°19′45″ W., in the northern foothills of the Brooks Range, northern Alaska.

Genus Saracenaria Defrance, 1824

Saracenaria dutroi Tappan, new species

Plate 68, Figures 14–16

Test free, early portion coiled, later uncoiling and rectilinear, triangular in section, periphery acute but without a keel; chambers increasing rapidly in size from the globular proloculus, becoming increasingly broader but enlarging very little in height, with considerable overlap, so that final chamber is about half again as high as the penultimate, sides of chambers flattened or slightly depressed centrally, apertural face flattened; sutures distinct, gently curved in the early portion, more nearly straight but oblique in the later portion, highest at the dorsal angle, wall calcareous, hyaline, finely perforate, surface smooth; aperture terminal at the dorsal angle, radiate, and slightly produced.

Length of holotype 0.78 mm., greatest breadth of side 0.31 mm., breadth of face 0.26 mm. Paratypes range from 0.26 to 0.73 mm. in length.

Remarks: *Saracenaria dutroi*, new species, differs from *S. saratogana* Howe and Wallace in being relatively narrower, with fewer and higher chambers, a more enrolled base, and more acutely angled margins.

This species occurs in the Grandstand and Topagoruk formations. The specific name is in honor of J. T. Dutro, Jr., geologist, U. S. Geological Survey.

Types and occurrence: Holotype (USNM P4533) from well cuttings at 1940–1950 feet in the Topagoruk formation; unfigured paratypes (USNM P4534) from a core at 438–443 feet, unfigured paratype (USNM P4535) from a core at 493–503 feet, unfigured paratypes (USNM P4536) from a core at 543–545 feet, all in the Grandstand formation; figured paratype (USNM P4537) from a core at 1,080–1,087 feet, unfigured paratype (USNM P4538) from well cuttings at 2,300–2,310 feet, and unfigured paratype (USNM P4539) from well cuttings at 2,460–2,470 feet, all in the Topagoruk formation; all in Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Figured paratype (USNM P4540) from well cuttings at 1,392–1,397 feet, in the Topagoruk formation, in Arcon Point Barrow core test 1, at lat. 71°19′30″ N., long. 156°40′ W., southwest of Point Barrow, northern Alaska.

Family Polymorphinidae d'Orbigny, 1846

Genus Pyrulinoides Marie, 1941

Pyrulinoides thurrelli Tappan, new species

PLATE 68, FIGURE 13

Test free, elongate, fusiform in outline, circular in section; chambers added 180 degrees apart, in a biserial arrangement, much overlapping, increasing rapidly in size, final chamber extending back about three-fourths the distance to the base on one side, only about one-third the distance on the opposite side; sutures strongly oblique, flush; wall calcareous, finely perforate, surface smooth; aperture terminal, radiate.

Length of holotype 0.94 mm., greatest breadth 0.42 mm. Paratypes range from 0.60 to 1.12 mm. in length.

REMARKS: *Pyrulinoides thurrelli*, new species, differs from *P. obesa* Marie in the larger size, more regularly fusiform outline, greater chamber overlap, more oblique sutures, and fewer, larger chambers. The species occurs in the Grandstand and Topagoruk formations. The specific name is in honor of R. F. Thurrell, geologist, formerly with U. S. Geological Survey.

TYPES AND OCCURRENCE: Holotype (USNM P4553) from a core at 466–476 feet in the Grandstand formation, in Skull Cliff core test 1, lat. 70°55′ N., long. 157°38′ W., between Point Barrow and Point Franklin, northern Alaska.

Unfigured paratype (USNM P4554) from a core at 523–533 feet in the Grandstand formation and unfigured paratype (USNM P4555) from well cuttings at 3,160–3,170 feet in the Topagoruk formation, both from Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Family Buliminidae Jones, 1876

Genus Praebulimina Hofker, 1951

Praebulimina seabeensis Tappan, new species

PLATE 69, FIGURES 14–16

Test free, elongate, flaring, chambers in a high spiral, triserially arranged, low, somewhat inflated, increasing gradually in size, those of final whorl somewhat higher and subglobular; sutures distinct, depressed, horizontal; wall calcareous, finely perforate, surface smooth; aperture loop-shaped, at the inner margin of the final chamber, extending up into the chamber face.

Length of holotype 0.26 mm., breadth 0.18 mm. Paratypes range from 0.10 to 0.42 mm. in length.

REMARKS: *Praebulimina seabeensis*, new species, differs, from *P. venusae* (Nauss) in the larger size, more bluntly rounded base, less flared test, and lower final whorl of chambers.

The specific name refers to the Seabee formation, in which this species is found.

TYPES AND OCCURRENCE: Holotype (USNM P4564) and unfigured paratypes (USNM P4565) from a core at 591–601 feet, figured paratype (USNM P4566) and unfigured paratype (USNM P4567) from a core at 519–529 feet, and figured paratype (USNM P4568) and unfigured paratypes (USNM P4569) from a core at 584–591 feet, all in the Seabee formation, in Umiat test well 1, at lat. 69°23′52″ N., long. 152°19′45″ W., west of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Family Discorbidae Cushman, 1927

Genus Eurycheilostoma Loeblich and Tappan, 1957

Eurycheilostoma grandstandensis Tappan, new species

PLATE 68, FIGURES 19–25

Test free, trochoid, extremely high spired, all whorls visible dorsally, only the final whorl visible on the concave, widely umbilicate ventral side, triserial throughout, chambers increasing gradually in size in the early portion, forming a gradually enlarging spire, later chambers enlarging rapidly and becoming inflated, so that there may be a distinct change in the diameter of the test with the final whorl, the final chamber occupying one-half to two-thirds of the ventral side of the test; sutures distinct, flush in the early spire, depressed in the later portion; wall calcareous, finely but distinctly perforate, surface smooth, aperture an arch at the inner margin of the final chamber on the ventral side opening into the umbilicus, partly covered over by an extensive although narrow flap which has a serrate border in all well preserved specimens, an apertural reentrant occurring at both extremities of this flap.

Greatest diameter of holotype 0.16 mm., height of spire 0.31 mm. Paratypes range from 0.13 to 0.26 mm. in diameter.

REMARKS: This species differs from *E. altispira* Loeblich and Tappan in being larger and extremely high spired and in having the conical early portion commonly followed by an abrupt flaring of the final whorl. It differs from *E. robinsonae*, new species, in being much higher spired, with a pointed apex and nearly flush sutures in the early development.

Eurycheilostoma grandstandensis occurs in the Grandstand and Topagoruk formations.

TYPES AND OCCURRENCE: Holotype (USNM P4595), figured paratypes (USNM P4596 a,b), and unfigured paratype (USNM P4597) from a core at 555–565 feet, unfigured paratypes (USNM P4598) from a core at 433–438 feet, unfigured paratypes (USNM P4599) from a core at 543–545 feet, all from the Grandstand formation; unfigured paratypes (USNM P4600) from a core at 1,030–1,040 feet, unfigured paratypes (USNM P4601) from a core at 1,070–1,080 feet, unfigured paratypes (USNM P4602) from a core at 1,247–1,267 feet, figured paratype (USNM P4603) and unfigured paratypes (USNM P4604) from a core at 1,360–1,370 feet, figured paratype (USNM P4605) and unfigured paratypes (USNM P4606) from well cuttings at 1,580–1,590 feet, unfigured paratypes (USNM P4607) from well cuttings at 1,760–1,770 feet, unfigured paratypes (USNM P4608) from well cuttings at 1,870–1,880 feet, unfigured paratypes (USNM P4609) from a core at

1,967–1,977 feet, unfigured paratypes (USNM P4610) from a core at 2,024–2,026 feet, and figured paratypes (USNM P4611a,b) from well cuttings at 2,390–2,395 feet, all from the Topagoruk formation; all from Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Unfigured paratypes (USNM P4612) from well cuttings at 4,180–4,190 feet, unfigured paratypes (USNM P4613) from well cuttings at 4,220–4,230 feet, unfigured paratypes (USNM P4614) from well cuttings at 4,340–4,350 feet, all from the Topagoruk formation, in Umiat test well 1, at lat. 69°23′52″ N., long. 152°19′45″ W., west of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratypes (USNM P4615) from well cuttings at 4,140–4,150 feet and unfigured paratypes (USNM P4616) from a core at 5,585–5,595 feet in the Topagoruk formation in Umiat test well 2, at lat. 69°23′04″ N., long. 152°05′01″ W., north of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratypes (USNM P4617) from 2,390 feet below the top of the Grandstand formation (field sample 47A Dt 227), about 4¾ miles airline upstream from the mouth of Fossil Creek, a small north-flowing tributary to the Colville River, at approximately lat. 69°19′20″ N., long. 152°28′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by R. L. Detterman, 1947.

Unfigured paratypes (USNM P4618) from the lower part of a 50-foot section of the Topagoruk formation (field sample 47A Tr 167) on the west fork of Birthday Creek, at approximately lat. 69°12′30″ N., long. 156°47′ W., which flows south into the Awuna River, north-central Alaska. Collected by M. L. Troyer, 1947.

Eurycheilostoma robinsonae Tappan, new species

PLATE 70, FIGURES 8–11

Test free, trochoid, conical, dorsal side in a much elevated spire of about four volutions, ventral side concave with open and extensive umbilicus, periphery rounded; chambers inflated, increasing rapidly in size, later ones becoming semilunar in dorsal view but relatively high as seen in edge view, final whorl with only three chambers, the last chamber occupying about three-fifths the area of the ventral side; sutures distinct, slightly depressed; wall calcareous, finely but distinctly perforate, surface smooth; aperture ventral, an arch at the inner margin of the final chamber, opening into the umbilicus and partly covered by a ventral umbilical flap of the chamber, which has a serrated border, and an apertural reentrant into the chamber face at each extremity of the flap.

Greatest diameter of holotype 0.29 mm., height of spire 0.31 mm. Paratypes range from 0.13 to 0.29 mm. in diamter.

REMARKS: *Eurycheilostoma robinsonae*, new species, differs from the associated *E. grandstandensis* in the much lower spire and more regular increase in chamber size. It differs from E. *altispira* Loeblich and Tappan in being about twice as large and higher spired.

This species is found in the Grandstand and Topagoruk formations. The specific name is given in honor of Florence Robinson, geologist, U. S. Geological Survey.

TYPES AND OCCURRENCE: Holotype (USNM P4584) and unfigured paratypes (USNM P4585) from a core at 651–661 feet in the Topagoruk formation, in Arcon Point Barrow core test 1, at lat. 71°19′30″ N., long. 156°40′ W., southwest of Point Barrow, northern Alaska.

Figured paratype (USNM P4586) from a core at 264 feet in the Grandstand formation, in Skull Cliff core test 1, at lat. 70°55′ N., long. 157°38′ W., between Point Barrow and Point Franklin, northern Alaska.

Figured paratype (USNM P4587) and unfigured paratypes (USNM P4588) from a core at 2,024–2,026 feet, unfigured paratypes (USNM P4589) from well cuttings at 1,760–1,770 feet, and unfigured paratypes (USNM P4590) from well cuttings at 1,840–1,850 feet, all in the Topagoruk formation, in Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Figured paratype (USNM P4591) and unfigured paratypes (USNM P4592) from a marine zone at the base of a 640-foot section, in an unnamed, dominantly marine lower unit of the Nanushuk group found in the western area (field sample 47 A Ba 67), on the north limb of a syncline, just north of the Utukok River and southwest of a small tributary at approximately lat. 69°14′ N., long. 160°37′ W., about 70 miles east-northeast of Cape Beaufort, in the northern foothills of the Brooks Range, northern Alaska. Collected by W. L. Barksdale, 1947.

Genus Nanushukella Tappan, new genus

TYPE SPECIES: *Nanushukella umiatensis* Tappan, new species. (Derivation: *Nanushuk*, formational group in Alaska + *ella*, L., diminutive; gender, feminine.)

Test free, trochoid, planoconvex, low spired, ventrally umbilicate, periphery rounded; all chambers visible on the convex dorsal side, only the relatively few of the last whorl visible ventrally; sutures distinct, oblique dorsally, radiate ventrally; wall calcareous, relatively coarsely perforate, surface smooth; aperture ventral, a low arch along the broad umbilical margin of the final chamber and opening into the umbilicus, with a narrow fimbriate lip or flap extending its full length, the apertures of all earlier chambers of the final whorl remaining open beneath their flaps along the sutures from the umbilicus about one-half the distance to the periphery.

REMARKS: *Nanushukella*, new genus, differs from *Conorbina* Brotzen in having a more extensive umbilical aperture and an open umbilicus and in having all earlier apertures of the final whorl remaining open.

Nanushukella umiatensis Tappan, new species

PLATE 69, FIGURES 1–10

Test free, trochoid, planoconvex, with a low rounded spire of about 2½ volutions, periphery rounded; chambers increasing rapidly in size, semilunate in dorsal view, about six in the early whorls and commonly only four in the final whorl, last chamber occupying about one-third of the ventral side; sutures distinct, flush dorsally and may be somewhat limbate, ventrally depressed and nearly radial, with a slight forward swing from the outer margin of the aperture to the periphery; wall calcareous, coarsely perforate, surface smooth; aperture ventral, a low arch at the umbilical margin of the final chamber extending over much of the length of its ventral margin, bordered above by a narrow apertural flap that has a fimbriate margin, apertures of earlier chambers of the final whorl all remaining open and visible, radiating from the open umbilicus.

Greatest diameter of holotype 0.29 mm., height 0.16 mm. Paratypes range from 0.18 to 0.34 mm. in diameter.

REMARKS: This species differs from *Conorbina conica* Lozo in having higher and less arcuate chambers as seen dorsally, a lower, more rounded spire, less oblique sutures, the characteristic umbilical aperture with serrated lip, and the earlier apertures remaining open with later development.

It is found in the Grandstand, Topagoruk, and Fortress Mountain formations.

TYPES AND OCCURRENCE: Holotype (USNM P4619), figured paratype (USNM P4620), and unfigured paratypes (USNM P4621) from a core at 565–578 feet, unfigured paratypes (USNM P4622) from a core at 206–211 feet, figured paratypes (USNM P4623a–c) and unfigured paratypes (USNM P4624) from a core at 238–256 feet, unfigured paratypes (USNM P4625) from a core at 338–348 feet, figured paratypes (USNM P4626a,b) and unfigured paratypes (USNM P4627) from a core at 348–358 feet, unfigured paratypes (USNM P4628) from a core at 438–443 feet, figured paratype (USNM P4629) and unfigured paratypes (USNM P4630) from a core at 513–523 feet, and unfigured paratypes (USNM P4631) from a core at 543–545 feet, all from the Grandstand formation, Nanushuk group; unfigured paratype (USNM P4632) from a core at 1,758–1,768 feet and unfigured paratype (USNM P4633) from well cuttings at 1,990–2,000 feet, both in the Topagoruk formation; all in Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Unfigured paratype (USNM 106138) from well cuttings at 1,560–1,570 feet, unfigured paratypes (USNM 106137) from a core at 1,850–1,855 feet, unfigured paratypes (USNM 106136 and P4634) from well cuttings at 2,610–2,620 feet, from the Topagoruk formation, in Umiat test well 2, at lat. 69°23′04″ N., long. 152°05′01″ W., north of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratypes (USNM P4635) from the Fortress Mountain formation (field sample 49A Tr 611), east of Castle Mountain, on the east fork of Torok Creek, at lat. 68°33′35″ N., long. 152°38′30″ W., in the southern foothills of the Brooks Range, northern Alaska. Collected by I. L. Tailleur, 1949.

Unfigured paratype (USNM P4636) from the middle part of the Fortress Mountain formation (field sample 49A Pa 468), 1½ miles southwest of Castle Mountain, along a tributary to Castle Creek, which flows north to join the Kiruktagiak River, at lat. 68°33′40″ N., long. 151°51′ W., in the southern foothills of the Brooks Range, northern Alaska. Collected by W. W. Patton, Jr., 1949.

Unfigured paratype (USNM P4637) from seismograph party 47 test hole, line 14A–48, shot hole 37, at 190–200 feet, in the Grandstand formation, at lat. 71°17′54″ N., long. 156°43′21″ W., northern Alaska.

Figured paratypes (USNM P4570a,b) and unfigured paratypes (USNM P4571), all from the Cretaceous, probably equivalent to the lower part of the Nanushuk group of the eastern areas (field sample 47A Tm 10), in a section of intermittent exposures along the Utukok River, at lat. 69°07′30″ N., long. 160°54′ W., about 70 miles due east of Cape Beaufort in the northern foothills of the Brooks Range, northern Alaska. Collected by R. M. Thompson, 1947.

Unfigured paratype (USNM P4572) from the lower part of the Fortress Mountain formation (field sample 49A Pa 81), on Fortress Creek, north of Fortress Mountain, at lat. 69°35′25″ N., long. 153°11′ W., in the southern foothills of the Brooks Range, Northern Alaska. Collected by W. W. Patton, Jr., 1949.

Genus Eponides Montfort, 1808

Eponides morani Tappan, new species

PLATE 70, FIGURES 1–7

Test free, trochoid, biconvex, periphery subacute, all chambers of the 1½ to 2½ whorls visible dorsally, only the 6 to 8 chambers of the final whorl visible on the umbilicate ventral side, chambers relatively narrow, extending backward at the periphery; sutures distinct, thickened, flush dorsally, ventrally nearly radial although slightly curved; wall calcareous, hyaline, relatively coarsely perforate, surface smooth; aperture broad and low, a ventral, interiomarginal slit, extending from the umbilical region almost to the peripheral margin.

Greatest diameter of holotype 0.47 mm., thickness 0.18 mm. Paratypes range in diameter from 0.26 to 0.49 mm.

REMARKS: *Eponides morani*, new species, differs from *E. repandus* (Fichtel and Moll) in being much smaller, with a lower spire, in having 6 to 8 chambers rather than 5 or 6 in the final whorl, in lacking a keel, and in having a lower more slitlike aperture.

The specimen selected as holotype was obtained from well cuttings, but it was selected as type because it was the most complete and best preserved specimen

found; its true stratigraphic age is inferred from the occurrence of other specimens in core samples.

This species is found in the Grandstand and Topagoruk formations; its appearance in older rocks is probably due to contamination of the well cuttings.

It is named for P. F. Moran, administrative assistant, U. S. Geological Survey.

Types and occurrence: Holotype (USNM P4638) from well cuttings at 5,670–5,680 feet, probably from the Topagoruk formation, found as contamination in the underlying Jurassic rocks; figured paratypes (USNM P4639a–c) and unfigured paratype (USNM P4640) from a core at 2,235–2,245 feet, unfigured paratype (USNM P4641) from a core at 2,275–2,285 feet, all from the Topagoruk formation; unfigured paratype (USNM P4644) from well cuttings at 3,760–3,770 feet, unfigured paratype (USNM P4642) from well cuttings at 4,180–4,190 feet, and figured paratype (USNM P4643) from well cuttings at 5,190–5,200 feet, all of Topagoruk age but found as contamination in older beds; all from Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Figured paratype (USNM P4645) and unfigured paratype (USNM P4646) from the upper part of the Torok formation (Topagoruk formation equivalent) (field sample 47A Wh 543), and figured paratype (USNM P4647) and unfigured paratype (USNM P4648) from the upper part of the Torok formation (Topagoruk formation equivalent) (field sample 47A Wh 541), all on the north flank of the Awuna anticline, along Birthday Creek, which flows south into the Awuna River, at lat. 69°11′30″ N., long. 156°41′ W., in the northern foothills of the Brooks Range, north-central Alaska. Collected by C. L. Whittington, 1947.

Unfigured paratypes (USNM P4659) from a core at 2,789–2,797 feet in the Grandstand formation, in Oumalik test well 1, at lat. 69°50′18″ N., long. 155°59′24″ W., approximately 125 miles airline south of Point Barrow, northern Alaska.

Genus Globorotalites Brotzen, 1942

Globorotalites alaskensis Tappan, new species

Plate 69, Figures 11–13

Test free, trochoid, dorsally flat to slightly convex, ventrally strongly convex and centrally umbilicate, periphery subacute; chambers increasing rapidly in size and becoming more oblique dorsally, extending back along the periphery, the six to eight chambers of the final whorl may be slightly less elevated than the peripheral keel, presenting an almost collapsed appearance; sutures distinct, dorsally oblique, those of final whorl somewhat thickened and elevated dorsally, radial and flush or slightly depressed ventrally; wall calcareous, finely perforate, surface smooth; aperture interiomarginal, ventral, a low slit extending from the umbilicus almost to the periphery.

Greatest diameter of holotype 0.31 mm., thickness 0.13 mm. Paratypes range from 0.16 to 0.36 mm. in diameter.

Remarks: *Globorotalites alaskensis*, new species, differs from *G. multisepta* (Brotzen) in being one-third as large, in being less elevated ventrally, in having fewer chambers per whorl, and in the chambers being broader and the sutures less oblique.

It occurs in the Grandstand and Topagoruk formations.

Types and occurrence: Holotype (USNM P4649) and unfigured paratypes (USNM P4650) from a core at 680–690 feet in the Grandstand formation; unfigured paratypes (USNM P4651) from a core at 1,429–1,439 feet and figured paratype (USNM P4652) from well cuttings at 1,770–1,780 feet in the Topagoruk formation; all in Umiat test well 2, at lat. 69°23′04″ N., long. 152°05′01″ W., north of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Figured paratype (USNM P4653) and unfigured paratype (USNM P4654) from a core at 206–211 feet, unfigured paratype (USNM P4655) from a core at 211–221 feet, and unfigured paratype (USNM P4656) from a core at 555–565 feet, all in the Grandstand formation, in Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Unfigured paratypes (USNM P4657) from well cuttings at 190–200 feet in the Grandstand formation, in Simpson core test 10, at lat. 70°57′34″ N., long. 155°17′27″ W., near Cape Simpson, northern Alaska.

Unfigured paratypes (USNM P4658) from a core at 874–885 feet in the Grandstand formation, in Simpson core test 25, at lat. 70°55′56″ N., long. 154°43′52″ W., near Cape Simpson, northern Alaska.

Family Chilostomellidae Brady, 1881

Genus Pallaimorphina Tappan, new genus

Type species: *Pallaimorphina ruckerae* Tappan, new species. (Derivation: *pallai*, Gr., plural of *palla*, f., ball + *morphe*, Gr., form or shape + *ina*, diminutive suffix; gender feminine.)

Test free, small, subglobular, trochoid, with broadly rounded periphery; chambers increasing rapidly but evenly in size as added, early chambers subglobular, later tending to become crescentic in dorsal view, four to five in the final whorl; sutures oblique dorsally, radial ventrally; wall calcareous, finely perforate, granular in structure, surface smooth; aperture a low sutural slit, extending from the umbilical region about half the distance to the periphery, bordered above by a narrow lip.

Remarks: *Pallaimorphina*, new genus, is closest in character to *Quadrimorphina* Finlay and may have given rise to that genus. It differs in the gradual chamber enlargement, and does not have the extremely high final chamber characteristic of the genera *Allomorphina* and *Quadrimorphina*. The apertural flap of *Pallaimorphina* is also primitive, being extremely

narrow, and extending along the suture from the umbilicus toward the periphery rather than across the umbilical margin of the chamber as in the other genera mentioned above. Nevertheless the granular wall structure, trochoid coiling, and apertural flap definitely show the present genus to belong to the Chilostomellidae.

Pallaimorphina ruckerae Tappan, new species

PLATE 71, FIGURES 1–9

Test free, small, trochoid, rotund, and biconvex, periphery broadly rounded; four to five inflated chambers per whorl, increasing gradually in height and rapidly in length as added, so that chambers of final whorl are crescentic in dorsal view, about twice as long as high; sutures distinct, slightly depressed, curved and oblique dorsally, nearly straight and radial ventrally; wall calcareous, finely perforate, surface smooth; aperture a low sutural slit, extending from the umbilicus about half the distance to the periphery, bordered above by a narrow lip.

Greatest diameter of holotype 0.21 mm., thickness 0.16 mm. Paratypes range from 0.13 to 0.36 mm. in diameter.

REMARKS: *Pallaimorphina ruckerae*, new species, differs from *Quadrimorphina allomorphinoides* (Reuss) in lacking an extremely broad spatulate apertural flap, having instead only a very narrow one. It is also much smaller and the chambers are subglobular, increasing gradually in size, without developing the extremely radial elongate final chamber characteristic of *Q. allomorphinoides*. Very small young specimens of Reuss' species tend somewhat to resemble the present species, suggesting that this genus may be ancestral to *Quadrimorphina*.

The species occurs in the Grandstand, Topagoruk, and Fortress Mountain formations. It is named in honor of Florence Rucker, geologist, U. S. Geological Survey.

TYPE AND OCCURRENCE: Holotype (USNM P 4664) and figured paratype (USNM P4665) from a core at 533–543 feet, figured paratypes (USNM P4666a,b) and unfigured paratypes (USNM P4667) from a core at 206–211 feet, unfigured paratypes (USNM P4668) from a core at 238–256 feet, figured paratype (USNM P4669) and unfigured paratypes (USNM P4670) from a core at 256–266 feet, figured paratypes (USNM P4671a,b) from a core at 273–283 feet, unfigured paratypes (USNM P4672) from a core at 338–348 feet, figured paratype (USNM P4673) from a core at 358–368 feet, unfigured paratypes (USNM P4674) from a core at 438–443 feet, unfigured paratypes (USNM P4675) from a core at 503–513 feet, unfigured paratypes (USNM P4676) from a core at 533–543 feet, unfigured paratypes (USNM P4677) from a core at 565–578 feet, unfigured paratypes (USNM P4678) from a core at 663–673 feet, all in the Grandstand formation; and unfigured paratypes (USNM P4679) from a core at 1,000–1,010 feet in the Topagoruk formation; all from Simpson test well 1, at lat. 70°57′05″ N., long. 155°21′45″ W., west of Cape Simpson, northern Alaska.

Figured paratype (USNM P4680) from a core at 464½ feet in the Grandstand formation, in Umiat test well 2, at lat. 69°23′04″ N., long. 152°05′01″ W., north of Umiat, in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratypes (USNM P4681) from a core at 256–264 feet and unfigured paratypes (USNM P4682) from a core at 461–466 feet all in the Grandstand formation, in Skull Cliff core test 1, lat. 70°55′ N., long. 157°38′ W., between Point Barrow and Point Franklin, northern Alaska.

Unfigured paratypes (USNM P4683) from a core at 558–568 feet in the Topagoruk formation, in Arcon Point Barrow core test 1, at lat. 71°19′30″ N., long. 156°40′ W., southwest of Point Barrow, northern Alaska.

Unfigured paratype (USNM P4684) from well cuttings at 2,545–2,550 feet in the Grandstand formation and unfigured paratype (USNM P4685) from well cuttings at 4,820–4,830 feet in the Topagoruk formation, all in Umiat test well 1, at lat. 69°23′52″ N., long. 152°19′45″ W., in the northern foothills of the Brooks Range, northern Alaska.

Unfigured paratypes (USNM P4686) from the Cretaceous, probably equivalent to the lower part of the Nanushuk group of the eastern areas (field sample 47A Ba 83), 903–1,043 feet above the base, south and east of the Utukok River and 2½ miles west of the confluence of Disappointment Creek with the Utukok River, at lat. 69°15′ N., long. 159°57′ W., about 70 miles east of Cape Beaufort, in the northern foothills of the Brooks Range, northern Alaska. Collected by W. L. Barksdale, 1947.

Unfigured paratype (USNM P4687) from the upper part of the Torok formation (Topagoruk formation equivalent) (field sample 47A Tr 161), on the north flank of the Awuna anticline, at lat. 69°11′42″ N., long. 156°45′ W., in the Awuna River region, northern foothills of the Brooks Range, northern Alaska. Collected by M. L. Troyer, 1947.

Unfigured paratypes (USNM P4688) from the Topagoruk formation (field sample 48A Wb 24), at the confluence of Reynard Creek with the Colville River, northeast of Noluk Lake, at lat. 69°06′30″ N., long. 159°27′ W., in the northern foothills of the Brooks Range, northern Alaska. Collected by E. J. Webber, 1948.

Unfigured paratype (USNM P4689) from the Fortress Mountain formation (field sample 49A Pa 90), on the north limb of the Fortress Mountain syncline on Fortress Creek, at lat. 68°35′10″ N., long. 153°10′30″ W., and unfigured paratype (USNM P4690) from the Fortress Mountain formation (field sample 49A Pa 94), at lat. 68°35′ N., long. 153°10′ W., on the syncline along Fortress Creek, tributary to the Ayiyak River,

396818—57——16

southwest of Fortress Mountain in the southern foothills of the Brooks Range, northern Alaska. Collected by W. W. Patton, Jr., 1949.

Unfigured paratypes (USNM P4691) from the Fortress Mountain formation (field sample 49A Pa 561), on Castle Creek, about 2¾ miles southwest of Castle Mountain, at lat. 68°33′15″ N., long. 152°52′30″ W., and unfigured paratypes (USNM P4692) from the Fortress Mountain formation (field sample 49A Pa 564), about 2½ miles southwest of Castle Mountain on Castle Creek, at lat. 68°33′10″ N., long. 152°52′15″ W., in the southern foothills of the Brooks Range, northern Alaska. Collected by W. W. Patton, Jr., 1949.

Unfigured paratypes (USNM P4693) from the Fortress Mountain formation (field sample 49A Tr 611), on the east fork of Torok Creek, east of Castle Mountain, at lat. 68°33′35″ N., long. 152°38′30″ W., in the southern foothills of the Brooks Range, northern Alaska. Collected by I. L. Tailleur, 1949.

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